Cranbrook Timber Supply Area
Timber Supply Review #3

Analysis Report

Version 3.0

May 11, 2004

Prepared For:

Cranbrook Timber Supply Area
Defined Forest Area Management (DFAM) Group

Tembec

BC
Timber
Sales

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More Information on the Timber Supply Review Process

This document was prepared to support an allowable annual cut determination by British Columbia's Chief Forester. To learn more about this process please visit the following website:

http://www.for.gov.bc.ca/hts/

Or contact:

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Comments and Questions

First Nations and public input are an important part of the Timber Supply Review process and you are encouraged to review the information in this document and forward any comments you have to Forsite Consultants Ltd. by **July 24, 2004**.

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If you have any questions or would like further information, please contact Cam Brown, RPF or Craig Robinson, RPF at (250) 832-3366.

A public presentation of the Analysis Report is planned for the evening of **June 22, 2004** at the Sandman Inn in Cranbrook from 6:00 - 8:30 PM.

Additional copies of this document are available on the web at www.forsite-sa.com/CranbrookTSR3/ or can be requested using the email address above.

Acknowledgements

Forsite would like to thank each of the parties that contributed to the TSR3 process in the Cranbrook TSA. The time and commitment provided by everyone contributed greatly to this document and allowed it to be completed in a timely fashion. We would like to specifically thank government staff for their timely provision of data and thorough review/approval process within expedited timeframes. We thank licensee staff for access to their time and prompt efforts in provided required information.

We also thank Al Neal, RPBio for his numerous contributions to the process and for his excellent job of contract administration/coordination.

We also want to recognize the contributions of the following firms in the delivery of this project:

- Derek De Biasio of Crane Management Consultants Ltd completed the socio-economic analysis included in this document, and
- Oliver Thomae, RPF of ArbourTech Forest Management Services and Reg Davis, RPF of Interior Reforestation Co. Ltd. assisted with the preparation of the data package.

Executive Summary

This document contains a timber supply analysis and socio-economic analysis specific to the Cranbrook Timber Supply Area (TSA). These analyses are an important part of the provincial Timber Supply Review (TSR) process. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TSA. A review of this type is completed at least once every five years in order to capture changes in data, practices, policy, or legislation influencing forest management in the TSA. The previous timber supply review (TSR2) was completed in December 1999 with a final Annual Allowable Cut (AAC) determination on January 1, 2001. The AAC was temporarily increased on January 8, 2004 to facilitate salvage of timber burned in the fires of 2003. This current review (TSR3) is working toward a new AAC determination to be in place before January 1, 2006.

The current allowable annual cut (AAC) is 941,000 cubic meters. This includes a three-year, 70,000 m^3 uplift for fire salvage, 838,000 m^3 to be harvested from the timber harvesting land base and two partitions, totaling 33,000 m^3, to be harvested from outside the timber harvesting land base. These partitions are for 380 ha in problem forest types and 230 ha in fire maintained ecosystem restoration areas excluded from the timber harvesting land base.

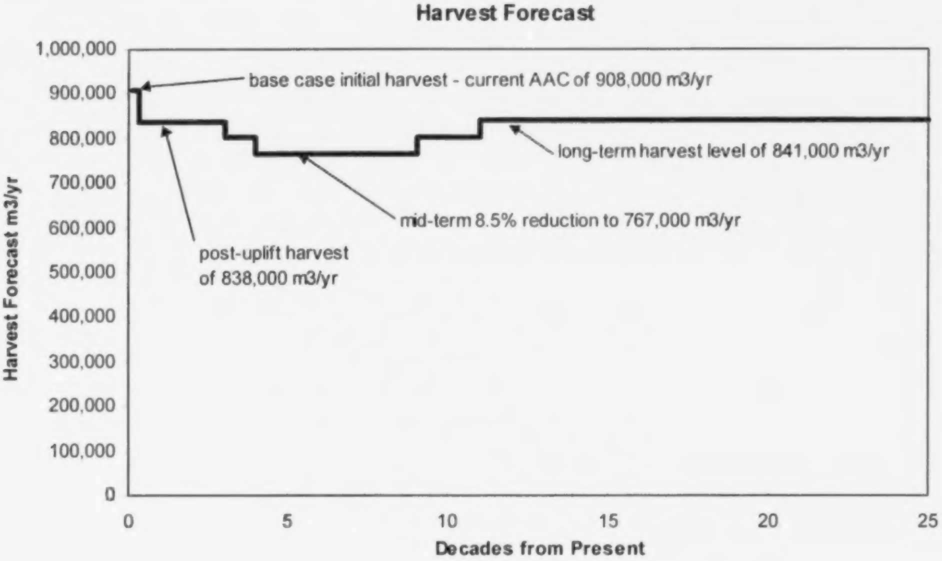
The TSR3 Data Package, a document providing detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis, was released in October 2003 and ultimately approved by Forest Analysis Branch on February 6, 2004. The release of this Analysis Report is the next step in the TSR3 process. Its purpose is to summarize the results of the timber supply analysis and provide a focus for public discussion. The contents of this report will provide British Columbia's Chief Forester with a large portion of the information that is needed to make an informed AAC determination.

This report focuses on a single forest management scenario that reflects current management practices in the Cranbrook TSA. In addition to this current management or "Base Case" scenario, an assessment of how results might be affected by land-base or forest management uncertainties has been completed using a number of sensitivity analyses.

The Cranbrook TSA covers approximately 1.24 million hectares in the south-eastern corner of British Columbia. The portion of this area considered available for timber production and harvesting under current management practices is called the timber harvesting land base (THLB). The THLB has been estimated through the analysis of spatial map layers. The result is a description of the area that is available for timber harvesting under TSA administrative structures. Based on these inputs, the THLB is estimated to be 416,196 ha, a decrease of 5.2% (22,994 ha) since the last timber supply review. The largest influence was a revised estimate of the operable area in the TSA. Since the last timber supply review for the Cranbrook TSA, many other changes affecting forest management and the extent of the timber harvesting land base have occurred. Changes effecting forest management include:

- The Kootenay Boundary Higher Level Plan Order (October 26, 2002) gives legal status to Landscape Units, Biodiversity Emphasis Options with specific Old and Mature Retention Targets, Connectivity Corridors, Caribou Management Areas, Scenic Corridors, and Enhanced Resource Development Zones.
- The Southern Rocky Mountain Management Plan (SRMMP) was implemented August 2003 for the eastern portions of the TSA.
- Biogeoclimatic Ecosystem Classification (BEC) mapping for the Cranbrook TSA was revised in 2002.
- Operability for the TSA was reviewed in 2003, to confirm the merchantability and economic viability of accessing forest stands in the TSA.
- Older Environmentally Sensitive Area (ESA) soils mapping has been replaced with more current and refined terrain stability mapping (both Level B and Level D mapping).
- Visual Quality Objectives (VQO's) were made known by the District Manager in August 2003.
- Field based ecosystem restoration mapping has been completed for approximately 50% of the ecosystems where it is required.

This report summarizes a base case analysis of the Cranbrook TSA. The base case scenario was developed to reflect current forest practices in the TSA and the resulting harvest flow was guided by provincial policy. The base case implements the current AAC uplift of 70,000 cubic meters for 3 years, for an initial harvest rate of 908,000 cubic meters per year. After 3 years of uplift, the harvest level is maintained at 838,000 cubic meters (the pre-uplift AAC), for another of 27 years. At 30 years, the harvest level drops in two steps, totaling 8.5%, to 767,000 cubic meters per year by decade 5, and then increases to the long-term harvest level of 841,000 cubic meters by the 11th decade.



Sensitivity analysis of the base case revealed that both short-term and long-term harvest levels are sensitive to changes in input assumptions.

Uncertainties that could alter the short-term harvest level are:

- the size of the timber harvesting land base,
- the net volumes realized from harvesting existing mature stands,
- the length of time it takes regenerated stands to become ready for harvest,
- the rate at which slow growing older stands are converted to more productive managed stands,
- the volume of timber available from Open Range / Open Forest restoration (initial treatments),
- the volume killed by mountain pine beetle over the next 10 years.

Uncertainties that could affect the long-term harvest level by at least 3% are:

- the size of the timber harvesting land base,
- future managed stand yields,
- the length of time it takes regenerated stands to become ready for harvest,
- management for ungulate winter range,
- the amount and genetic worth of select seed used, and
- the productivity of the land base (site index estimates).

Although these sensitivities indicate the potential for change, the base case scenario is felt to best represent current management in the Cranbrook TSA. Looking forward, a number of changes are likely to change timber supply in the mid- and long-term. These include new ungulate winter range guidelines, new caribou management guidelines, and improved site productivity estimates for managed stands. These changes will result in a net increase in timber availability throughout the planning horizon.

A socio-economic assessment of the importance of the forest industry to the Cranbrook TSA and the province was also completed. Based on facts and data collected, it was concluded that the base case harvest forecast of 838 000 m^3 (which extends for three decades) could annually support the following.

- estimated 948 PYs of total employment and $39.6 million of employment income in the Cranbrook TSA
- estimated 1 600 PYs of total employment and $62.0 million of employment income in the province
- estimated $11.9 million of stumpage and $28.1 million of total BC Government revenues

Since the base case harvest forecast and the current AAC are projected to be the same for several decades, a stable AAC will provide neither positive nor negative impacts to the regional economy. The economy of the Cranbrook TSA is relatively diversified and minor changes in the regional forest sector do not have significant consequences for the Cranbrook area's overall economic wellbeing.

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1.0 Introduction

Timber supply is the amount of timber available for harvest over time. Assessing timber supply involves consideration of a wide range of physical, biological, social, and economic factors that can influence the acceptable rate of timber harvesting within a management unit. These factors encompass both the timber and non-timber values found in our forests and ensure that timber harvesting objectives are balanced against concerns for wildlife, biodiversity, watershed health, and recreational opportunities.

This document contains a timber supply analysis and socio-economic analysis specific to the Cranbrook Timber Supply Area (TSA). These analyses are an important part of the provincial Timber Supply Review (TSR) process. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TSA. A review of this type is completed at least once every five years in order to capture changes in data, practices, policy, or legislation influencing forest management in the TSA. The previous review analysis (TSR2) was completed in December 1999 with a final Annual Allowable Cut (AAC) determination on January 1, 2001. This current review (TSR3) is working toward a new AAC determination to be in place before January 1, 2006.

The Data Package, a document providing detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis, was released in October 2003[1] and ultimately approved by Forest Analysis Branch on February 6, 2004. The release of this Analysis Report is the next step in the TSR3 process. Its purpose is to summarize the results of the timber supply analysis and provide a focus for public discussion. The contents of this report will provide the British Columbia's Chief Forester with a portion of the information that is needed to make an informed AAC determination. **This report does not define a new AAC – it is intended only to provide insight into the likely future timber supply of the Cranbrook TSA and recommend a future course of action to the Chief Forester.** The final harvest level decision will be made by the Chief Forester and published along with their rationale in an AAC Determination document.

This report focuses on a single forest management scenario that reflects current management practices in the TSA. In addition to this current management or "Base Case" scenario, an assessment of how results might be affected by uncertainties has been completed using a number of sensitivity analyses. Together, the sensitivity analyses and the Base Case form a solid foundation for discussions among stakeholders about appropriate timber harvesting levels.

It is recognized that ongoing treaty negotiations with First Nations have the potential to impact timber supply in the TSA. However, "current management" was the underlying assumption for the analysis and no treaty settlement has yet been reached. The final results from treaty negotiations will be modeled in subsequent timber supply reviews when this information comes available. This Timber Supply Review does not limit, and is not intended to limit ongoing treaty negotiations between the Ktunaxa Kinbasket Treaty Council, British Columbia and Canada.

1.1 Background

The Ministry of Forests (MOF) is currently implementing a policy framework that establishes obligations and opportunities for collaborative forest management within the province's 37 timber supply areas (TSA). This framework is commonly referred to as the Defined Forest Area Management (DFAM) initiative. Under DFAM, specified licensees and BC Timber Sales (BCTS) assume a collective responsibility for timber supply analysis and specified forest health activities within each timber supply area.

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[1] The Cranbrook TSR3 Data Package v1.0 was released in October, 2003 and was used for public and First Nations consultation. Version 3.0 was submitted to government for review on January 30, 2004 and was approved by Forest Analysis Branch on February 19, 2004.

The Cranbrook DFAM group consists of Tembec Industries Inc., Galloway Lumber Company Ltd., and BCTS. This group has chosen to take on the responsibilities of timber supply and forest health with the knowledge that the Forest Investment Account is currently funding the initiatives. Thus, for TSR3, the DFAM group is leading the Timber Supply Review process. To deliver on this commitment, the planning and analysis work associated with the TSR was tendered and subsequently awarded to Forsite Consultants Ltd. of Salmon Arm. In addition, the DFAM group acquired the services of Al Neal to fill a contract monitoring and co-ordination role.

Government agencies still play a key role in this TSR process – they set and enforce standards and are responsible for approval of the final Data Package and Analysis Reports (Table 1). The MoF may also provide technical support, facilitate resolution of issues, and validate technical information. Various resource specialists in the Ministries of Sustainable Resource Management (MSRM) and Water, Land and Parks (WLAP) may also play key roles. The following table shows the general roles and responsibilities associated with the timber supply analysis leading to an AAC determination.

Table 1. Roles and responsibilities

DFAM Group Obligations	Government Obligations	
	Forest Analysis Branch	District And Regional Staff
Compile data needed for the timber supply analysis, including forest cover and other data related to forest and land characteristics, administration and management regimes. Provide a summary of the data, management assumptions, and modeling methods to be applied in the timber supply analysis in a Data Package document.	Set standards for the data package	Provide data, information, and knowledge of current practices in the TSA.
Provide information to the public and First Nations and summarize comments received for government.		
Make any necessary changes to the data package and submit for government approval.	Review and accept the data package (focus on how data is to be applied in Timber supply analysis).	Review and accept the data package (focus on confirming current practice).
Perform and document a timber supply analysis according to standards provided by the Ministry of Forests.	Provide technical advice and set standards for the analysis and reporting.	
Submit an Analysis Report and digital file containing the complete dataset used in the timber supply analysis.	Review and accept (together with the Chief Forester) the analysis report.	Review the analysis report to ensure local issues and current practices are adequately reflected.
Provide information to the public and First Nations and summarize comments received for government.		Conduct formal consultation.
Provide additional information as required by the Chief Forester.	Compile and prepare information for presentation to the Chief Forester at the determination meetings.	Assist in compiling and preparing information for presentation to the Chief Forester at the determination meetings.

1.2 Guiding Legislation / Policy

For the Cranbrook TSA, the following legislation and policy guide management on the crown forested land base:

- Forest Practices Code of BC Act and /or Forest and Range Practices Act
- Kootenay-Boundary Higher Level Plan Order, October 26, 2002.
- Southern Rocky Mountain Management Plan, August 2003.
- Kootenay-Boundary Land Use Plan Implementation Strategy, 1997.
- Cranbrook TSA AAC Uplift Determination, January 2004.
- District Manager's Instructions for Forest Development Plan Preparation, 2001.
- District Manager Direction Letter on Visual Quality Objectives, August 2003.
- Provincial Wildlife Tree Management Policy and Recommendation, 2000.
- Landscape Unit Planning Guide, 2000.
- Identified Wildlife Management Strategy, Feb 1999.

2.0 Description of the Cranbrook Timber Supply Area

The Cranbrook Timber Supply Area (TSA) is within the boundaries of the Rocky Mountain Forest District and is administered by the district office in Cranbrook. It is situated in the southeastern corner of British Columbia within the Southern Interior Forest Region (Figure 1).

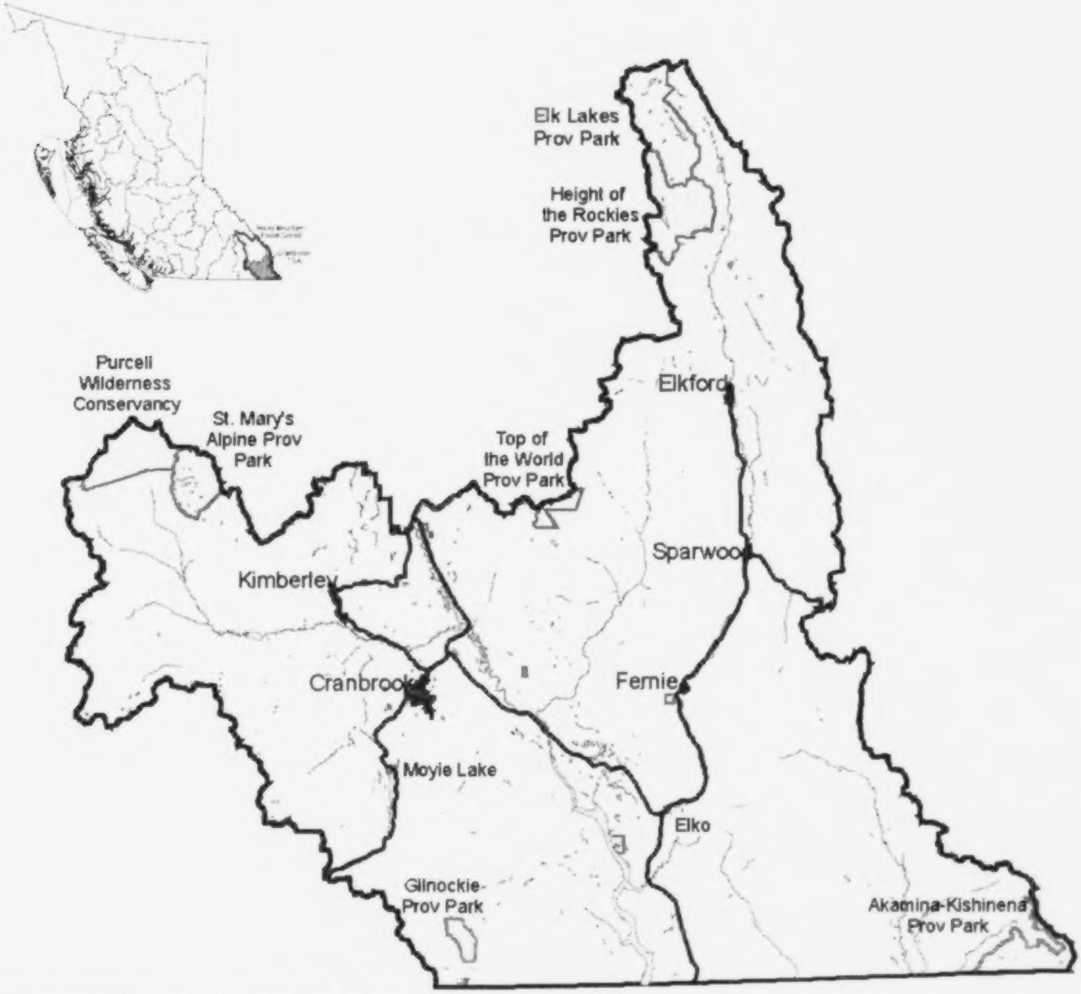
Elk Lakes Prov Park
Height of the Rockies Prov Park
Purcell Wilderness Conservancy
St. Mary's Alpine Prov Park
Top of the World Prov Park
Elkford
Sparwood
Kimberley
Cranbrook
Fernie
Moyie Lake
Elko
Gilnockie Prov Park
Akamina-Kishinena Prov Park

Figure 1. Cranbrook Timber Supply Area Map.

The TSA covers approximately 1.24 million hectares. The Cranbrook TSA is bounded by the Skookumchuck Valley to the north, the Canada-U.S. border to the south, the Alberta border to the east, and the southern Purcell Mountains height-of-land to the west. Three major physiographic regions characterize the varied terrain of the Cranbrook TSA: the Rocky Mountains in the east, the Purcell Mountains in the west, and the Rocky Mountain Trench in the middle. The trench varies in width from five kilometers in the north to 27 kilometers near Cranbrook. The western side of the Trench features irregular, comparatively low foothills gradually rising until they merge with the extremely rugged backbone of the Purcell Mountains. In contrast, the eastern side of the trench is characterized by an abrupt rise and continuous wall of mountains broken only by tributary valleys.

The major drainage in the Cranbrook TSA is the Kootenay River which flows southward through the Rocky Mountain Trench. Its major tributaries are the Moyie, St. Mary, Wildhorse, Bull and Elk rivers. The Flathead River flows south into the U.S. in the southeastern part of the TSA. The Libby Dam on the Kootenay River, just south of the U.S. border, forms Lake Koocanusa which extends into the Cranbrook TSA. Moyie Lake is the largest natural lake in the TSA, followed by St. Mary and Wasa lakes.

The Cranbrook TSA includes the cities of Cranbrook, Kimberley and Fernie, and the smaller communities of Sparwood and Elkford. Some small, unincorporated communities and a number of rural residences are dispersed throughout the TSA.

The Cranbrook TSA offers many and varied opportunities for recreation and tourism, due to its lakes, parks and spectacular mountains. The area is well traveled as major highways provide access to Alberta and the national and provincial parks in the Canadian Rockies. Within the Cranbrook TSA, there are the Akamina-Kishinena, Elk Lakes, and Gilnockie Provincial Parks as well as numerous smaller parks and recreation areas and portions of the Purcell Wilderness Conservancy, Height of the Rockies Provincial Park, and Top of the World Provincial Park.

The current allowable annual cut (AAC), which took effect in January 2004, is 941,000 cubic meters. This includes a 70,000 m3 uplift for fire salvage, 838,000 m3 to be harvested from the timber harvesting land base and two partitions to be harvested from outside the timber harvesting land base. These partitions are for 380 ha in problem forest types and 230 ha in fire maintained ecosystem restoration areas exlcuded from the timber harvesting land base.

2.1 First Nations

Most First Nations people in the Cranbrook TSA are part of the Ktunaxa people. They have traditional territory within the TSA, and archaeological evidence suggests the Ktunaxa have inhabited the East Kootenay region since the last glaciation over 10,000 years ago. In 1884, reserves for two First Nations groups were established at St. Mary's and Tobacco Plains. These continue to exist as First Nation communities with a combined population of approximately 400. Non-status Ktunaxa, as well as other status and non-status First Nations people such as Cree, Sioux, and Peigan, area also considered resident in the Cranbrook TSA. The total First Nations population within the TSA is estimated to be about 1100.

The Ktunaxa-Kinbasket Tribal Council entered the provincial treaty process in December 1993 and is currently in Stage 4 of the six-stage process. The Council has submitted a comprehensive land claim which covers the southeast corner of the province, including the Cranbrook TSA. Members of the tribal council include the St. Mary's and Tobacco Plains Bands, as well as three bands based outside the Cranbrook TSA who also have territorial claims to the area.

First Nations are employed in the forest sector, particularly in silviculture, fire fighting, harvesting and processing. The Tobacco Plains Band has a small sawmill and logging operation which employs about 12 people. Total employment is approximately 20 to 25 person-years, about 7.5% of the First Nations labour force. First Nations have expressed concern that they do not receive an equitable share of forest industry employment. Other concerns include:

- the effects of logging on fish and wildlife;
- the need to integrate the use of the timber resource with other sectors, including tourism, trapping, hunting, fishing and other traditional, spiritual and commercial uses;
- need to preserve archaeological and cultural sites;
- forest management practices.

A traditional-use survey has been completed in the Cranbrook TSA. It focuses on oral presentations by community members to clarify which lands in the TSA were used traditionally. In addition, a number of Archaeological Overview Assessments have been completed to identify sites of potential archaeological significance.

It is recognized that ongoing treaty negotiations with First Nations have the potential to impact timber supply in the TSA. However, "current management" was the underlying assumption for the analysis and no settlement has yet been reached. The final results from treaty negotiations will be modeled in subsequent timber supply reviews when this information comes available. This Timber Supply Review does not limit, and is not intended to limit ongoing Treaty negotiations between the Ktunaxa Kinbasket Treaty Council, British Columbia and Canada.

2.2 The Environment

The Cranbrook TSA contains six biogeoclimatic zones, an indication of the climatic and biological diversity in this area. Refer to Figure 2 for an area breakdown.

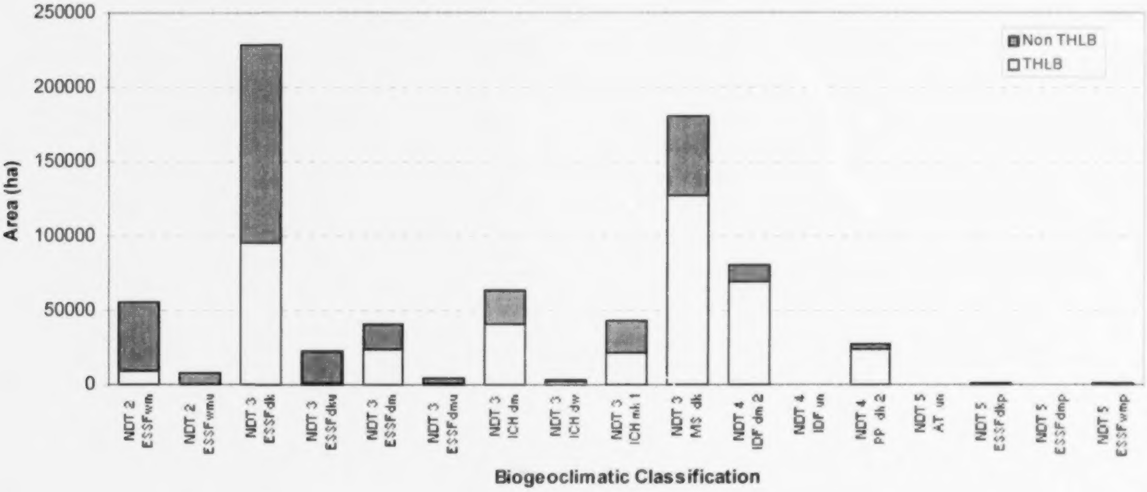

Figure 2. Biogeoclimatic Ecocsystem Classification of the Cranbrook TSA

The Ponderosa Pine Zone occurs at low elevations (700 to 900 meters) in very dry valleys of the Rocky Mountain Trench. Summers in this zone are hot and dry resulting in large moisture deficits during the growing season. Winters are cool with light snow cover. Forests are dominated by ponderosa pine, and historically tended to be open and park-like with an understory of grasses. Douglas-fir, trembling aspen and birch also occur on moister sites. Over the last 70 years, fires have been excluded from these area due to suppression activities and fine fuel reduction by cattle grazing. Consequently, these areas are increasingly characterized by a dense understory of immature and regenerating ponderosa pine and Douglas-fir.

The Interior Douglas-fir Zone also occurs in the Rocky Mountain Trench, generally between the Ponderosa Pine Zone and the Montane Spruce Zone (between 800 and 1200 meters). The continental climate is characterized by warm, dry summers, a fairly long growing season and cool winters. Moisture deficits are common during the growing season. Douglas-fir is the climax tree species in this zone, and historically, frequent low intensity fires created transitional woodlands and open grasslands. Other species include ponderosa pine at lower elevations; western larch and lodgepole pine at higher elevations; and cottonwood, spruce and aspen on moister sites such as floodplains. As in the Ponderosa Pine Zone, these areas are increasingly characterized by a dense understory of immature and regenerating Douglas-fir.

The Montane Spruce Zone is found at mid-elevations, often between the Interior Douglas-fir Zone and the Engelmann Spruce-Subalpine Fir Zone (between 1200 and 1600 meters). This zone is characterized by cold winters and moderately short, warm summers. Moisture deficits can occur during the growing season. Although subalpine fir and varieties of spruce are the dominant, climax tree species, one of the most distinctive features of this zone is the extensive even-aged stands of lodgepole pine that have formed following wildfire. Other common species found in this zone are Douglas-fir, western larch, western red cedar, trembling aspen and cottonwood.

The Interior Cedar-Hemlock Zone occurs at low to middle elevations (700 to 1500 meters) in the wetter portions of the Purcell and Rocky Mountains. This zone has a climate dominated by easterly moving air masses that produce cool wet winters and warm dry summers. Snow melt minimizes soil moisture deficits in the summer. This is the most productive zone in the interior of B.C. and also has the highest diversity of tree species of any zone in the province. Western red cedar, western hemlock and hybrid white spruce dominate the rare climax forests that occur in the Cranbrook TSA. Other species are Douglas-fir, lodgepole pine, white pine, western larch, ponderosa pine, birch, trembling aspen and cottonwood.

The Engelmann Spruce-Subalpine Fir Zone is the uppermost forested zone, lying below the Alpine Tundra from 1600 to 2000 meters. Growing seasons are cool and short while winters are long and cold. Forests are continuous at the lower elevations of this zone, but at higher elevations became more patchy where islands in areas of heath, meadow and grassland. Engelmann spruce and subalpine fir are the dominant climax tree species, but whitebark pine, lodgepole pine, alpine larch and trembling aspen are also common.

The Alpine Tundra Zone lies above the Engelmann Spruce-Subalpine Fir Zone, and is by definition treeless although stunted (or krummholz) trees are common at the lower elevations of this zone. Overall, rock, ice and grassy meadows dominate this zone.

The Cranbrook TSA is unique in North America in the density and diversity of ungulate populations, other large mammals, small mammals and birds. This wealth of wildlife is made possible by the great variety of habitat types available in the area. Species include elk, mule deer, whitetail deer, moose, Rocky Mountain bighorn sheep, mountain goat, caribou, black bear, grizzly bear, cougar, lynx, marten, raptors and owls. The valley floor of the Rocky Mountain Trench offers high quality ungulate habitat due to its limited snowfall and low elevation (800 meters above sea level).

The Cranbrook TSA also supports a high value sport fishery in its lakes and river systems, particularly the Kootenay and Flathead Rivers and their tributaries. The most common game fish are cutthroat trout, rainbow trout, bull trout, Rocky Mountain whitefish and kokanee.

There are wildlife species in the TSA which are at risk due to declining populations across the province. There are 12 red-listed (Endangered or Threatened) and 26 blue-listed (Species of Concern) species found in the Cranbrook TSA (Table 2). Since TSR2, three new species (the butterfly, Dione Copper, fisher and the southern population of the caribou) have been red-listed and eight new species have been blue-listed. The rubber boa, previously blue-listed during TSR2, has been reclassified as Yellow-Listed – a species to still monitor.

Table 2. Red- and blue-listed wildlife species that occur or potentially may be found in the Cranbrook TSA

Red-listed (Endangered or Threatened)		**Blue-listed (Species of Concern)**	
Scientific Name	English Name	Scientific Name	English Name
Ascaphus montanus	Rocky Mountain Tailed Frog	*Aeronautes saxatalis*	White-throated Swift
Buteo swainsoni	Swainson's Hawk	*Ardea herodias herodias*	Great Blue heron, herodias subspecies
Falco mexicanus	Prairie Falcon	*Asio flammeus*	Short-eared Owl
Falco peregrinus anatum	Peregrine Falcon, anatum subspecies	*Botaurus lentiginosus*	American Bittern
Lycaena dione	Dione Copper*	*Chrysemys picta*	Painted Turtle*
Martes pennanti	Fisher*	*Clethrionomys gapperi galei*	Southern Red-backed Vole, galei subspecies
Otus kennicottii macfarlanei	Western Screech-Owl, macfarlanei subspecies	*Colias meadii*	Mead's Sulphur*
Rana pipiens	Northern Leopard Frog	*Corynorhinus townsendii*	Townsend's Big-eared Bat*
Rangifer tarandus pop. 1	Caribou (southern population)*	*Cottus bairdi hubbsi*	Columbia Mottled Sculpin, hubbsi subspecies
Sphyrapicus thyroideus nataliae	Williamson's sapsucker, nataliae subspecies	*Dolichonyx oryzivorus*	Bobolink
Tamias ruficaudus ruficaudus	Red-tailed Chipmunk, ruficaudus subspecies	*Everes comyntas*	Eastern Tailed Blue*
Taxidea taxus	Badger	*Grus canadensis*	Sandhill Crane
		Gulo gulo luscus	Wolverine, luscus subspecies
		Melanerpes lewis	Lewis's Woodpecker
		Myotis septentrionalis	Northern Long-eared Myotis
		Numenius americanus	Long-billed Curlew
		Oncorhynchus clarki lewisi	Cutthroat Trout, lewisi subspecies*
		Otus flammeolus	Flammulated Owl
		Ovis canadensis	Bighorn Sheep
		Parnassius clodius altaurus	Clodius Appolo, altaurus subspecies*
		Plethodon idahoensis	Coeur d'Alene Salamander*
		Pyrgus communis	Checkered Skipper*
		Salvelinus confluentus	Bull Trout
		Tamias minimus oreocetes	Least Chipmunk, oreocetes subspecies
		Tympanuchus phasianellus columbianus	Sharp-tailed Grouse, columbianus subspecies
		Ursus arctos	Grizzly Bear

Source: Conservation Data Center database query, March 2004

* new species added since TSR2.

2.3 Integrated Resource Management Considerations

Integrated resource management is a basic premise for the practice of forestry in the Cranbrook TSA. Timber harvesting is planned and managed in such a way that allows a wide range of other values to co-exist on the land base. The manner in which each value is considered is dictated by federal or provincial legislation or BC government policy. Examples of these are the federal Fisheries Act, the Forest Practices Code, the Forest and Range Practices Act, the Kootenay Boundary Higher Level Plan Order, the Kootenay Boundary Land Use Plan Implementation Strategy, and the Rocky Mountain Forest District Policy on Scenic Area Management.

These documents address requirements for a wide range of non-timber issues. The most significant ones influencing forest management in the Cranbrook TSA are:

- Biodiversity
- Riparian Habitat
- Domestic and Community Watersheds
- Fire Maintained Ecosystems
- Ungulate Winter Range

- Grizzly Bear
- Caribou
- Identified Wildlife (Goshawk, Bull trout, Lewis woodpecker, etc)
- Viewscapes in Scenic Corridors
- Forest Recreation

The areas affected by each of these non-timber resource values and the specific forest management practices required to address them are discussed in Section 10.1

Resource management in landscape units C14-18, 23-26 and part of C27 is directed by the *Southern Rocky Mountain Management Plan* (SRMMP). The SRMMP designates legally binding OGMAs and MMA's, the use of PEM-based ungulate winter range guidelines, riparian reserves, wildlife tree percentages, and numerous other landscape level guidelines.

2.4 Current Attributes of the Cranbrook TSA

This section of the document describes the current state of the Cranbrook TSA and provides descriptions and statistics useful for understanding the timber supply analyses presented later in the document. The Timber Harvesting Land Base (THLB) and Crown Forested Land Base (CFLB) referenced in this section are defined in detail in Section 3.1.

Approximately 51% of the total area of the Cranbrook TSA is considered Crown Forested Land Base (CFLB). The remaining 49% is not considered productive forest (i.e., rock, ice, alpine, etc.), or is not managed by the B.C. Forest Service (i.e., private, First Nations, woodlots, etc.). Within the CFLB, only about 55% is considered available for timber harvesting (33% of the total TSA). Refer to Figure 3 and Figure 4.

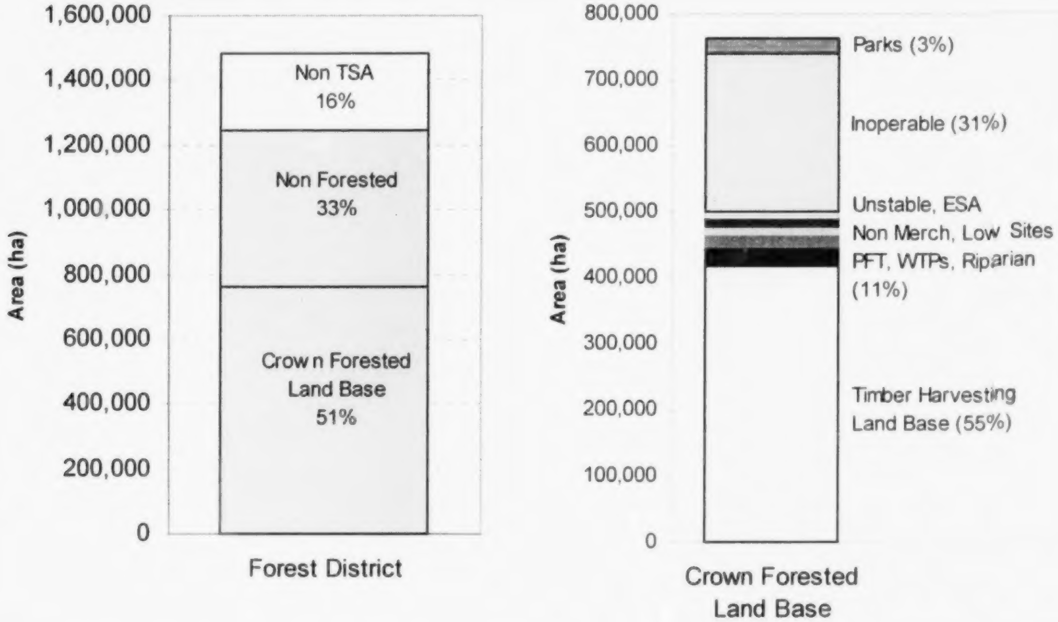

Figure 3. Land Base Summary: Total Land Base (left) and Crown Forested Land Base (right).

A coarse map illustrating the locations of the CFLB and THLB is shown below (Figure 4).

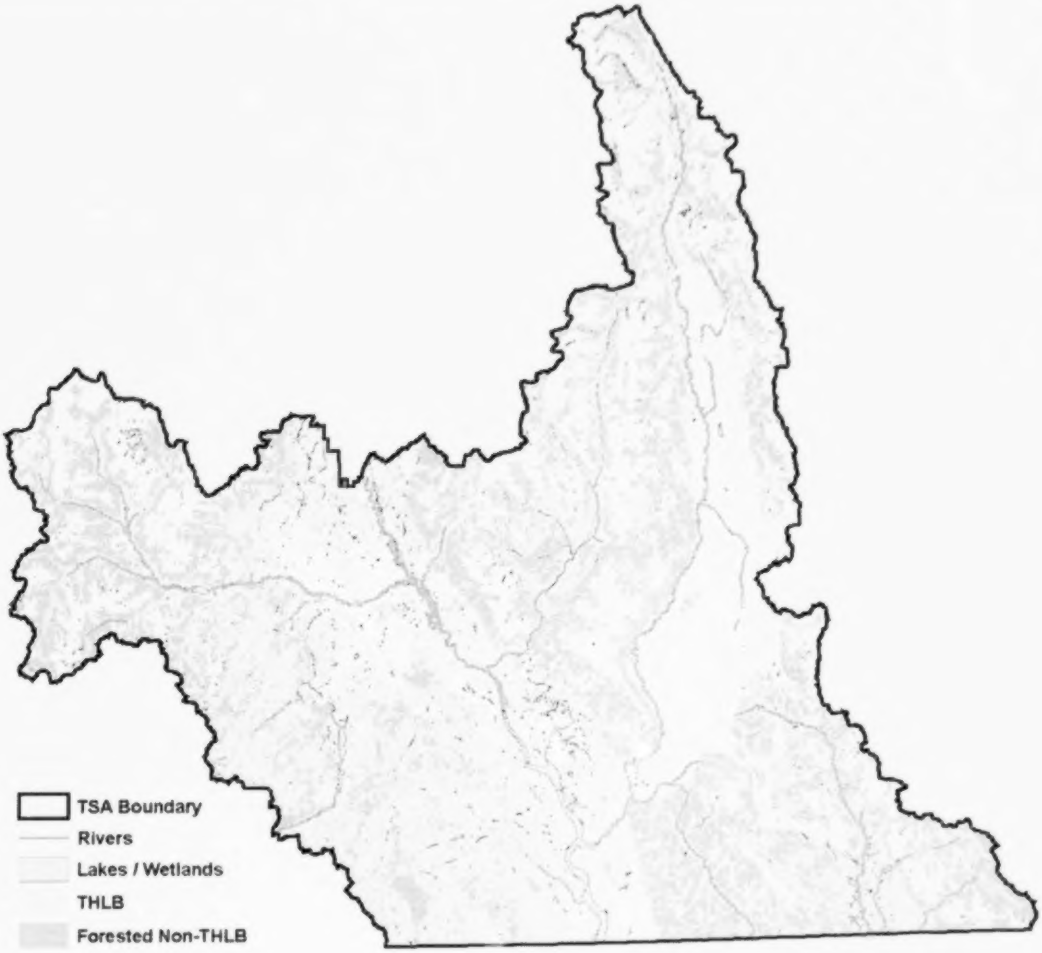

Figure 4. Timber Harvesting Land Base (THLB) and Crown Forested Land Base (CFLB) map.

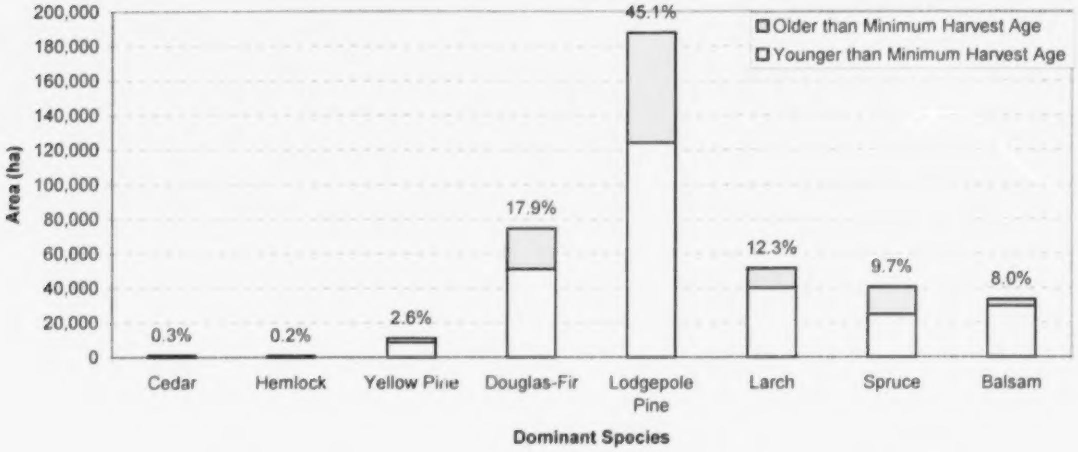

Figure 5. THLB Area by Dominant Tree Species Relative to Minimum Harvest Age

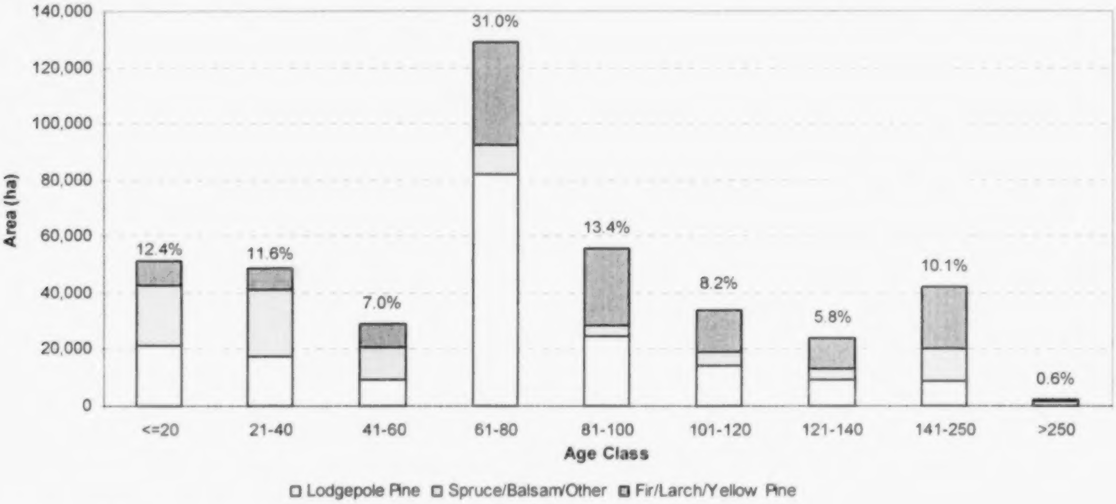

Figure 6. THLB area by Age Class and Leading Species

The forests of the Cranbrook TSA are dominated by lodgepole pine, Douglas-fir, larch, Engelmann spruce, and subalpine fir or balsam (Figure 5). Other tree species that occur less commonly in the TSA include ponderosa pine (yellow pine), western hemlock, western red cedar, whitebark pine, aspen, birch and western white pine. Figure 6 indicates that approximately 30% of the THLB is currently older than the minimum harvest ages defined in this document and Figure 6 indicates that 38% of the THLB is currently older than 80 years of age.

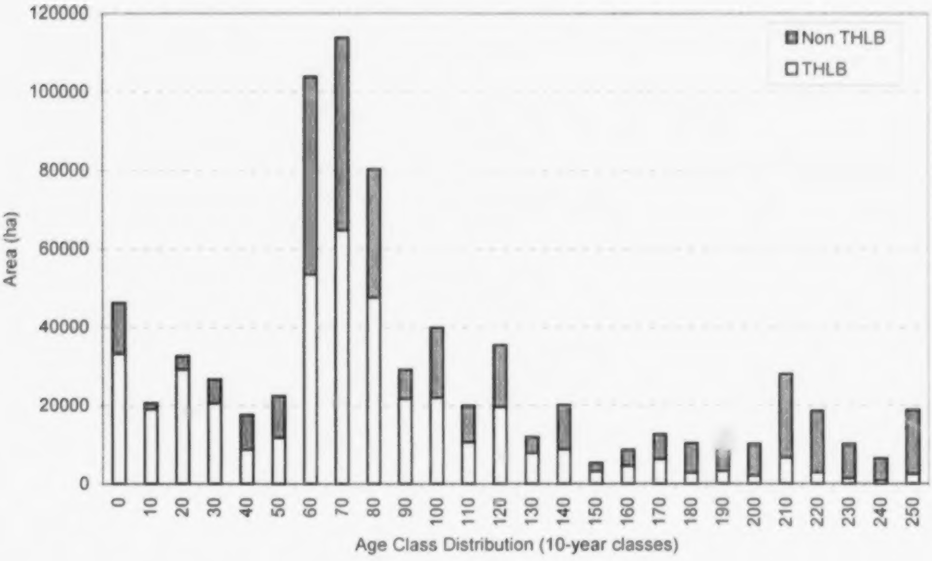

Figure 7. CFLB area by Age Class.

The age class structure over the entire CFLB is shown in Figure 7. Area is distributed over a wide range of age classes, with the most significant portion of the area falling in the 60-100 age class.

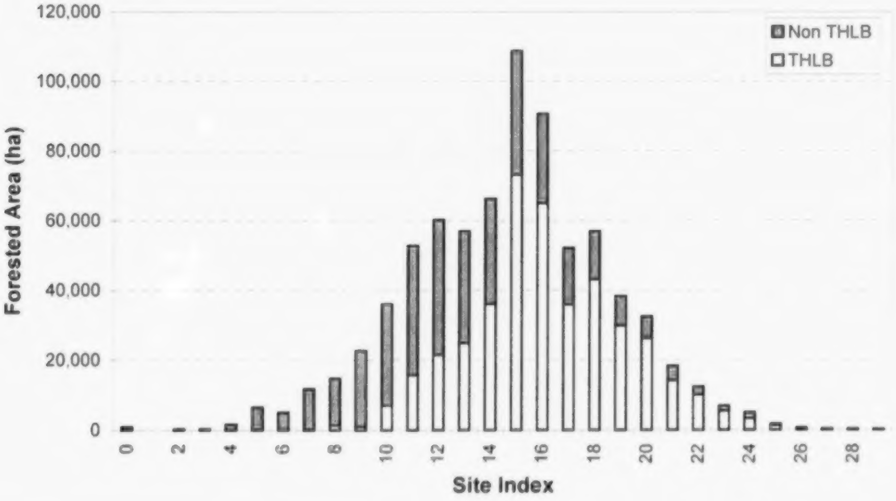

Figure 8. Site Productivity by land base type.

A summary of area by site productivity is shown in Figure 8 and indicates that the THLB area is skewed toward the portion of the land base with higher site indexes. As per the low site index netdown criteria listed in Appendix B, no THLB area occurs where site index is less than 8 and only small portions of 8-13 are included in the THLB. The average site index in the THLB is 16.1m and the average site index in the CFLB is 14.0m.

3.0 Timber Supply Analysis Methods

A large amount of information is required to complete a timber supply analysis. Information must be obtained in four broad categories: land base, forest inventory, management practices, and forest dynamics. This information is then translated into a model formulation that can explore sustainable rates of harvest in the context of integrated resource management. This section summarizes the data inputs, assumptions, and modeling procedures contained in Appendix B – Data Inputs and Modeling Assumptions.

3.1 Land Base Definition

The crown forested land base (CFLB) is the area of forest under provincial crown ownership. This is the total area of land base that contributes to landscape level objectives of biodiversity and resource management. The crown forested land base excludes non-crown land, woodlots, non-forest and non-productive areas. It also excludes federal crown lands such as First Nation Reserves.

The timber harvesting land base (THLB) is the area of the management unit where timber harvesting is anticipated to occur. At some point in time, either in the past or the future, timber in this area may be harvested by forest licensees under license to the province of BC. The timber harvesting land base excludes areas that are inoperable or uneconomic for timber harvesting, or are otherwise reserved for non-timber values. The THLB is contained entirely within the crown forested land base. Table 3 summarizes the land base for the Cranbrook TSA. A more detailed description of these areas and reductions can be found in Appendix B – Data Inputs and Modeling Assumptions.

Comparisons with TSR2 area netdowns are difficult because a different netdown hierarchy was used, but several key differences are discussed below:

- Total Forest District area in TSR3 is larger than TSR2 by approximately 1200 ha. TSR3 chose to use the sum of all the Landscape Units as the gross area instead of the forest district boundary.
- A TSR2 equivalent to the CFLB area in TSR3 is not available – all park ownership was removed as the first TSR2 netdown. As this netdown included both forested and non-forested area, it is impossible to recreate a TSR2 CFLB area.
- The size of the THLB in TSR3 appears to be smaller than TSR2 by 22,994 ha (5.2%) for a number of reasons detailed in Section 3.6 of this document. The effective difference between the two land bases is actually smaller than this because TSR2 reduced volume curves to address factors incorporated spatially through netdowns in TSR3 (existing WTP's, existing trails/landings). Both approaches would ultimately have had similar impacts on projected timber supply. The reasons behind the smaller THLB in TSR3 appear to be the removal of NP-Backlog areas, reduced operable area, removal of WTPs and existing trails and landings. These reductions were partially offset by fewer hectares removed for unstable terrain (TSR3 used terrain mapping in place of ESA soils mapping).

The TSR3 *long-term* THLB is significantly smaller (9.0%) than the reported TSR2 area. The difference can be partly explained by TSR3 excluding additional categories of land (future wildlife tree retention, trails/landings) beyond just future roads. TSR2 also reduced timber supply for these factors but chose not to reflect them in the long-term THLB area. The TSR2 value for future roads and the TSR3 estimate for the same category are also quite different. Part of the difference appears to be the inclusion of trails and landings in TSR3 but the TSR2 number still appears low.

Table 3. Timber harvesting land base area netdown summary

Factor	Total area (ha)	Effective Area (ha)*	% of Total Area	% of Crown forest
Total Area (old Cranbrook Forest District)	**1,484,302**	**1,484,302**	**100**	
Less:				
Private, Federal, Dominion and First Nation reserves	225,556	225,556	15.2%	
Woodlots, X-mas tree permits, Misc Leases	14,394	14,394	1.0%	
Total TSA Area	1,244,351	1,244,351		
Non-forest / Non-productive forest	495,333	451,926	30.4%	
Non-Commercial Brush	3,884	3,474	0.2%	
Backlog NSR (non-productive stands)	643	525	0.0%	
Unclassified existing roads, trails and landings	28,052	27,836	1.9%	
Total Crown Forested Land Base (CFLB)**		760,590	51.2%	100%
Less:	In CFLB:			
Parks and Reserves	22,389	22,389	1.5%	2.9%
Inoperable/Inaccessible	256,408	238,714	16.1%	31.4%
Operable/Inaccessible (Slope > 70%)	9,724	257	0.0%	0.0%
Unstable Terrain	17,175	5,871	0.4%	0.8%
Environmentally Sensitive Areas (excluding Es – areas with extremely fragile or unstable soils)	60,937	7,341	0.5%	1.0%
Non-Merchantable	30,717	11,390	0.8%	1.5%
Low Sites	59,689	11,582	0.8%	1.5%
Problem Forest Types	163,852	17,856	1.2%	2.3%
Riparian Management Areas	42,567	26,740	1.8%	3.5%
Existing Wildlife Tree Patches	2,897	2,254	0.2%	0.3%
Timber Harvesting Land Base –THLB (ha)		**416,196**	**28.0%**	**54.7%**
Volume Reductions:				
Identified Wildlife Management Strategy	0%	0		
Future Wildlife Tree Patches and Inblock Retn (%)	2.7%	11,237		
Other Future Reductions:				
FMER Open Range		19,382		
Future roads, trails and landings		19,997		
Long-term Timber Harvesting Land Base (ha)		**365,580**		

* Effective netdown area represents the area that was actually removed as a result of a given factor. Removals are applied in the order shown above, thus areas removed lower on the list do not contain areas that overlap with factors that occur higher on the list. For example, the unstable terrain netdown only removes area from the crown, operable forested land base.

** Crown forest in this context denotes the forest area that contributes to forest management objectives, such as landscape-level biodiversity, wildlife habitat and visual quality. It does not include alpine forest or non-productive areas with trees species.

3.2 Forest Inventory Data

The forest cover inventory is a key component to the timber supply review of the TSA. The history of the forest cover inventory in the Cranbrook TSA is summarized below:

- The last forest cover inventory for the TSA was completed in 1992 using 1988 photos. Since then, periodic updates for disturbances, and projection of time-dependent attributes have occurred.
- The forest cover has been formally updated for disturbances to December 2000, except for the 82F/82J blocks that have been updated to December 2001. The database used in the analysis was further updated for disturbances to Jan 2003 using licensee data for logged areas.
- The forest cover attributes have been projected to January 1, 2003. This date represents time zero in the analysis work presented later.

- An audit of the inventory was completed in the late 1990's and indicated that natural stand volumes in the TSA were overestimated by the inventory by 5%, though the difference was not statistically significant.
- The volumes associated with partially harvested stands within the inventory (history record shows a percentage logging history) have been adjusted to account for over-prediction of volumes by VDYP. VDYP does not accurately reflect volume removal in partially harvested stands, so a manual adjustment to the volumes, to reduce them by the area disturbed, has been performed on these stands. (Refer to Section 11.5 for more detail.)

3.3 Management Practices

Management practice assumptions can be grouped into three broad categories: Integrated Resource Management, Silviculture, and Harvesting.

3.3.1 Integrated Resource Management

In order to accommodate the range of timber and non-timber resource objectives that occur within the TSA, forest cover requirements were applied within the timber supply model. These requirements maintain appropriate levels of specific forest types that are needed to satisfy objectives for wildlife habitat, visual quality, biological diversity, etc. Figure 9 below describes the types of management zones that occur in the TSA, while the specific forest cover requirements applied to each are discussed later in Section 14.0.

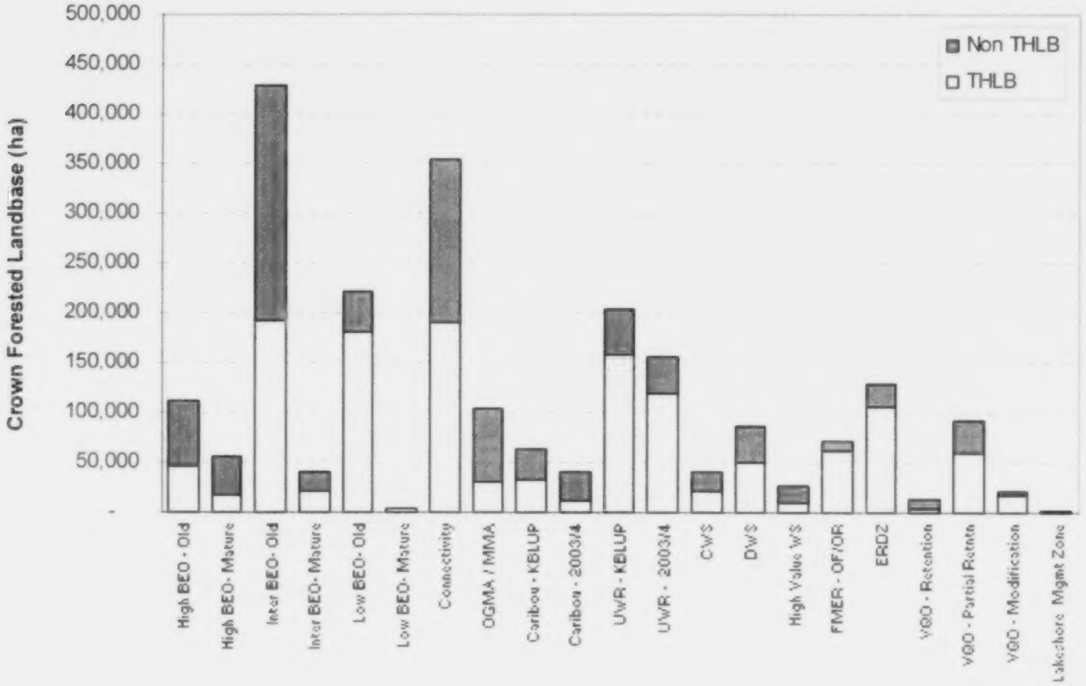

Figure 9. Integrated Resource Values: Area Summary by Land Base Type

A summary of the areas over which various non-timber resource values occur is provided in Table 4. These areas cannot be summed to determine the total area affected since many of the zones overlap on the land base.

Approximately 149,500 ha or 36% of the THLB falls outside of all areas where non timber resource constraints are applied in the model (i.e., outside spatial OGMAs/MMA's, UWR, Caribou, CWS, DWS, Mark Creek watershed, LMZ's, Open Range, Open Forest, and VQO polygons).

Table 4. Integrated Resource Values: Area Summary by Land Base Type

Name	Crown Forested Area (ha)	THLB (ha)	Non THLB (ha)	% CFLB	% THLB	Description
High BEO - Old	111,426	45,202	66,224	14.6%	10.8%	Biodiversity Emphasis Options define the amount of old and/or mature that must be retained in each LU/BEC variant combination.
High BEO- Mature	55,585	17,992	37,593	7.3%	4.3%	
Inter BEO- Old	429,725	191,607	238,118	56.4%	45.9%	
Inter BEO- Mature	40,064	20,485	19,579	5.3%	4.9%	
Low BEO- Old	221,018	180,448	40,570	29.0%	43.2%	
Low BEO- Mature	4,219	2,928	1,291	0.6%	0.7%	
Connectivity	354,580	190,186	164,394	46.5%	45.6%	
OGMA / MMA	103,600	31,402	72,198	13.6%	7.5%	Area of Spatial OGMA/MMA.
Caribou - KBLUP	62,655	32,265	30,390	8.2%	7.7%	Caribou habitat areas in base case.
Caribou - 2003/4	40,627	11,262	29,365	5.3%	2.7%	New caribou habitat area (sensitivity)
UWR - KBLUP	203,581	157,071	46,511	26.7%	37.6%	Ungulate winter range in base case.
UWR - 2003/4	155,269	118,443	36,826	20.4%	28.4%	New ungulate winter range (sensitivity)
Community Watersheds	41,132	21,009	20,123	5.4%	5.0%	(CWS)
Domestic Watersheds	87,351	50,550	36,801	11.5%	12.1%	(DWS)
High Value Watersheds	26,487	9,611	16,876	3.5%	2.3%	Wigwam
Lakeshore Mgmt Zone	2,179	719	1,460	0.3%	0.2%	
FMER - OF/OR	70,921	61,475	9,447	9.3%	14.7%	
ERDZ	129,549	105,183	24,366	17.0%	25.2%	
VQO - Retention	12,747	3,188	9,559	1.7%	0.8%	Visual Quality Objectives
VQO - Partial Retntn	91,518	59,450	32,068	12.0%	14.2%	
VQO - Modification	20,429	17,131	3,298	2.7%	4.1%	

3.3.2 Silviculture

Historical and current silvicultural practices occurring in the TSA have been included in the model. These include:

1. Silvicultural systems (clearcut vs partial cutting systems),
2. Regeneration assumptions such as establishment method (plant vs natural), species distribution, and establishment density,
3. Regeneration delay (time between harvesting and when the site becomes stocked with crop trees)
4. Use of select seed, and
5. Treatment of Backlog and current Not Satisfactorily Restocked (NSR) stands.

In TSR3, all harvesting outside the Open Forest and Open Range restoration areas was modeled as clearcut with reserves or short-term shelterwood systems. It is recognized that many blocks have mature trees retained in clumps, patches or as scattered stems to meet various management objectives. An in-block retention study was completed in March 2004 to provide an estimate of the amount of volume being left within 'clearcut' areas across the TSA so that a volume reduction factor could be applied in TSR3 to address this variation on partial cutting.

3.3.3 Timber Harvesting

Assumptions around timber harvesting practices have also been included in the model and include:

- Minimum harvest ages that ensure a viable log is produced and long-term volume production is maximized. (Section 15.2)
- Minimum economic criteria for log size and stand volumes (Section 15.2).
- Harvest priorities across the land base. For example, stands burnt in 2003 are salvage logged prior to the cutting of green timber (see Section 15.5)

Land base definition criteria (unstable slopes, inoperable areas, low sites, etc). These assumptions are outlined in detail in Appendix B – Data Inputs and Modeling Assumptions.

3.4 Forest Dynamics

Forest dynamics refers to the changing state of the forest through time. The state of the forest changes as it ages or grows and responds to natural or human caused disturbances. The ways in which the model addresses these issues are described below.

3.4.1 Growth and Yield Projections

Timber growth and yield refers to the prediction of the growth and development of forest stands over time and the associated volume yields that would occur with harvesting. For modeling purposes, stands of similar characteristics, growth rates, and management are grouped together into Analysis Units (AUs). Analysis Units are described in Appendix B. The attributes of each AU are input into growth and yield models to predict gross and net volume per hectare at various stand ages. The estimate of net timber volume in a stand assumes a specific utilization level, or set of dimensions, that establishes the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters near the base and the top of a tree.

Two growth and yield models were used to estimate timber volumes for the Cranbrook TSA analysis. The Variable Density Yield Prediction (VDYP) model supported by the Ministry of Sustainable Resource Management, Terrestrial Information Branch, was used for estimating timber volumes for all existing natural stands and all coniferous stands that will be harvested in the future by partial harvesting. The table interpolation program for stand yields (TIPSY)*, developed by the B.C. Forest Service, Research Branch was used to estimate timber volumes for both existing and future managed stands. Existing managed stands are those that are currently under 20 years of age, or older stands that have a history of planting and/or density control practices. Future managed stands are stands that will regenerate after they are harvested by the model during the planning horizon (excluding partial cut stands).

Based on timber volume estimates, the current timber inventory or growing stock on the timber harvesting land base is approximately 48.3 million cubic meters. Most of this growing stock (about 30.4 million cubic meters, or 62.9% of the total) is currently merchantable; that is, in stands older than minimum harvestable age.

3.4.2 Disturbances

The timber supply model relies upon three mechanisms to disturb stands. Harvesting is the most common method of disturbance in the model (clearcut or partial cutting) but natural disturbance mechanisms are also modeled:

Unsalvaged losses in the timber harvesting land base:

> Each year timber volume is damaged or killed on the THLB and not salvaged or accounted for by other factors. These losses are due to a number of factors that cause tree mortality, including insects, disease, blowdown, snowpress, wildfires, etc. In order to capture losses from catastrophic natural events in the THLB, the model 'harvests' an extra volume of timber in each time period that is set aside. Endemic pest losses are dealt with through factors applied in the growth and yield models. The annual unsalvaged losses applied in this analysis are 77,241 m^3/yr and is consistent with the value used in TSR2.
>
> Estimated unsalvaged loss estimates address the loss of merchantable volume from mature stands. Losses associated with immature stands also impact the rate at which timber becomes available in the TSA but little data is available to estimate the extent or impact of these losses. These disturbances will be captured during periodic inventory updates and reflected in subsequent TSR's.

Disturbances outside the timber harvesting land base:

> Because stands outside of the THLB contribute toward several forest cover objectives (i.e. landscape level biodiversity), it is important that the modeled age class distributions for these stands remain consistent with natural processes. By simulating natural disturbances in these stands, a natural age class distribution can be maintained in the model and a realistic contribution toward seral goals ensured. An area of 1384 ha is disturbed each year in the analysis to prevent age classes in the non-contributing land base from becoming unrealistically old during modeling.
>
> For more information on how these issues were handled in the model, refer to Section 14.5.1.1.

The 2003 fires have been addressed separately in the model. Stands within the fire boundaries were assumed dead at time zero in the model. If these stands were not harvested within 3 years, their volume was assumed to be lost and their age were regenerated. Stands too young for salvage and stands outside the THLB were regenerated at time zero.

3.5 Timber Supply Analysis Methods

The Forest Service Simulator (FSSIM) version 3.2 was used to complete this timber supply analysis. FSSIM was developed by the Ministry of Forests Forest Analysis Branch and has been used continuously in the province for many years. It is a well-documented and well-understood model that is designed to work well with BC's forestry policy and practices. FSSIM is a spatially-implicit model that allows for the modeling of constraints and harvesting with the ability to group and define forest units (classes) with geographic or ecological similarities. FSSIM can be as detailed or as generalized as required to meet the needs of the modeling objectives. FSSIM is a simulation model that permits the exploration of individual factors affecting harvest flow as well as allows for complete control over these factors. It provides results that are realistic, tangible, and repeatable.

Similar to other models, FSSIM assumes that trees grow according to provided yield projections and are harvested according to either a volume target or a specified objective set by the analyst, such as harvest volume maximization. FSSIM also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of green-up and old-forest requirements. For example, guidelines might specify that no more than 33% of the forest can be younger than a specified green-up age, or that 10% of the forest must be in older age classes to provide wildlife habitat.

The purpose of this analysis is to examine both the short and long-term timber harvesting opportunities in the Cranbrook TSA, in light of current forest management practices. Modeling assists the timber supply analyst in determining harvest flows associated with various scenario definitions. Scenarios are groups of assumptions defining the extent of the timber harvesting land base, timber volumes, and the management regimes. The dominant scenario presented in this report is the Base Case or current management scenario. Modeling was completed for 350 years for each scenario but only the first 250 years are presented in the report because the harvest level remains constant after that time.

The results of the analysis are an important part of the annual allowable cut determination process and aim to document future harvest flows that will not restrict future options in the TSA. **The results presented here do not define a new AAC – they are intended only to provide insight into the likely future timber supply of the Cranbrook TSA.** The final harvest level decision will be made by the Chief Forester and published along with his rationale in an AAC Determination document.

3.6 Major Changes from Previous Timber Supply Review (TSR2)

Since TSR2 changes have occurred in input data sets and management assumptions. In summary, the major changes from TSR2 are:

Changes impacting the size of the THLB:

- Operability for the TSA was reviewed in 2003, to confirm the merchantability and economic viability of accessing forest stands in the TSA. After areas were both removed (~7%) and added (~2%) to the old operability line, a net reduction of 18,538 ha to the THLB area resulted.
- The area known as the 'CPR Lands', in the Lower Elk Landscape Unit, has been confirmed to be in provincial crown ownership, thereby increasing the size of the crown forested land base by approximately 699 ha.
- Older Environmentally Sensitive Area (ESA) soils mapping has been replaced with more current and refined terrain stability mapping (both Level B and Level D mapping). This has reduced the amount of area deducted from the THLB for unstable soils.
- Backlog NSR (Not Satisfactorily Restocked) areas were reviewed by district staff and significant proportions were reclassified. This resulted in areas being removed from the land base, areas being classified as restocked, and areas being confirmed as actual NSR.
- The THLB area in this analysis excludes existing WTPs and existing trails/landings. TSR2 addressed these issues through yield curve reductions and thus they did not factor into the calculation of the THLB area.
- The netdown for existing trails and landings in this analysis is larger than in TSR2 because the percentage area reduction was applied to a larger area at the start of the analysis. Any stand with a logging history received the 9.5% area reduction as part of the existing road buffering exercise, whereas in TSR2, a 9.5% volume reduction was applied to stands under 31 years old.

Changes impacting the Management:

- Biogeoclimatic Ecosystem Classification (BEC) mapping for the Cranbrook TSA was revised in 2002. This has altered the area of some BEC variants and introduced new BEC variants that had not previously existed.
- New Visual Quality Objectives (VQO's) were made known by the District Manager for the TSA in August 2003 and are used in conjunction with HLPO scenic areas.
- The Higher Level Plan Order has given legal status to Landscape Units, Biodiversity Emphasis Options with Old and Mature Retention Targets, Connectivity Corridors, Caribou Management Areas, and Scenic Corridors.
- The Southern Rocky Mountain Management Plan (SRMMP) was implemented August 2003 for the eastern portions of TSA.

- TSR3 modeled the use of select seed for Pl, Sx, and Lw in the base case. No select seed was modeled in the TSR2 base case.
- Spatially explicit Old Growth and Mature Management Areas (OGMAs/MMAs) have been generated for use in the analysis. OGMAs are modeled in all LU/BEC combinations but MMA's are only modeled in the specific LU/BEC combinations identified by the HLPO in Oct 2002. TSR2 applied full mature targets in all LU/BEC's.
- Ecosystem Restoration mapping has been completed on a portion of the NDT4. This mapping replaces the algorithm generated Fire Maintained Ecosystem Restoration mapping used in TSR2, where it existed.
- WTP's / In-block Retention: In TSR2, WTP reductions were applied to clearcut analysis units using OAFs. For TSR3, the In-Block Retention Study results were used and indicated a 2.7% volume reduction be applied to all existing and managed stand volumes.

4.0 Base Case Analysis

The current allowable annual cut (AAC) for the Cranbrook TSA is 941,000 cubic meters, effective January 8, 2004. This AAC is comprised of:

- A 70,000 cubic meter per year, 3 year uplift designed to facilitate the salvage of approximately 210,000 cubic meters of timber damaged by catastrophic wildfires in 2003,
- A 838,000 cubic meter per year harvest from the timber harvesting land base, and
- Two partition harvests totaling 33,000 cubic meters per year to come from outside the timber harvesting land base. The partitions specify 308 hectares per year to come from problem forest types and 230 hectares per year to come from fire-maintained ecosystem restoration areas not in the THLB.

Thus the current AAC associated with the timber harvesting land base is 908,000 cubic meters per year, for three years starting in 2004. At the end of the three-year uplift, the AAC will return to 838,000 cubic meters per year.

Non-recoverable losses of timber to natural forces such as insects and fire are estimated to be 77 241 cubic meters per year within the Cranbrook TSA (see Section 13.0). Currently, these estimates are applied to each year of the entire 250-year period examined in this analysis, and are already subtracted from the graphs, reports and harvest forecasts presented in this report.

4.1 Alternative Harvest Flow Scenarios

Numerous alternative harvest forecasts are possible for a given set of modeling assumptions (i.e. the Base Case defined in Section 3.0). These alternative flows represent tradeoffs between short, mid, and long-term harvest level objectives. Figure 10 shows three potential harvest flows for the Cranbrook TSA Base Case assumptions.

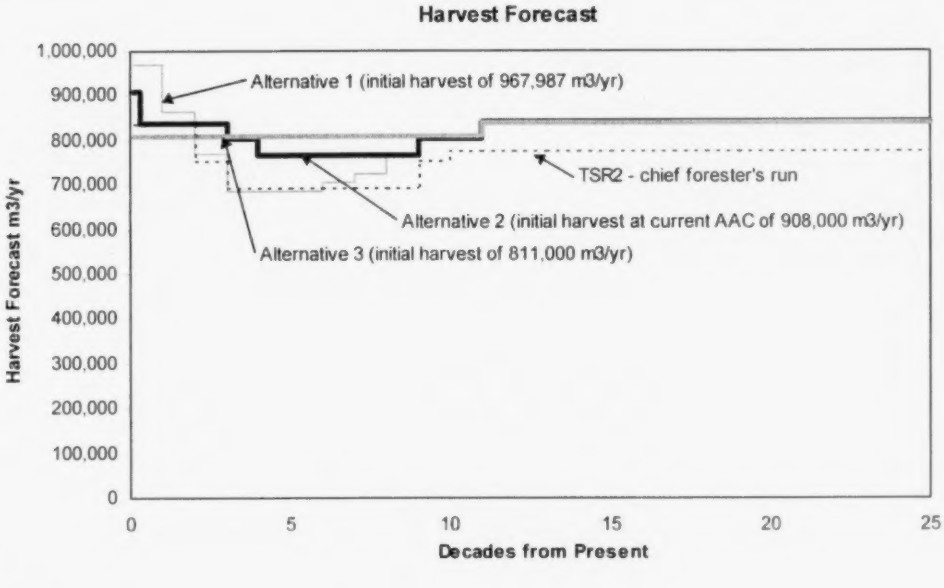

Figure 10. Alternative Harvest Forecasts of the Cranbrook TSA, 2004

Alternative 1 shows that the highest initial harvest rate that is possible is 967,987 cubic meters per year. This initial harvest can be maintained for only one decade before declining rapidly to a low of 684,887 cubic meters per year by the fourth decade, 29% below the initial harvest rate.

Alternative 2 seeks to maintain the pre-uplift AAC of 838,000 cubic meters per year for as long as possible while maximizing the long-term harvest level. Figure 10 shows the uplift AAC of 908,000 cubic meters harvested for 3 years, and then a decline to 838,000 cubic meters (the pre-uplift AAC) for a total of 27 years. After 3 decades, the harvest level drops in 2 steps, down to a harvest level of 767,000 cubic meters per year by the 5th decade, 8.5% below the pre-uplift AAC, and then increases to the long-term harvest level of 841,000 cubic meters by the 12th decade.

Alternative 3 is a non-declining harvest scenario where the initial harvest of 811,000 m3/yr is not allowed to drop. This harvest level is sustained for 9 decades where the rise to the long-term harvest level then begins in the tenth decade and results in a long-term level of 841,000 m3/yr.

For comparison reasons, the last harvest forecast from Timber Supply Review 2 is also shown. This was an unpublished run that the Chief Forester requested in support of his final AAC determination in 2000. More detail on difference between TSR2 and TSR3 forecasts can be found in Section 5.0.

4.2 Selected Base Case Harvest Flow

Alternative 2 from Figure 10 was selected as the base case for this timber supply analysis and is shown again in Figure 11. This harvest flow best fits the provincial policy of providing for a managed and gradual transition from short-term to mid term to long-term, by avoiding large and abrupt disruptions in timber supply. It also is consistent with the current AAC uplift for the TSA. All of the harvest attributes and forest level attributes presented in this section correspond with this Base Case harvest forecast. All sensitivity analyses that follow will be compared to this base case harvest forecast.

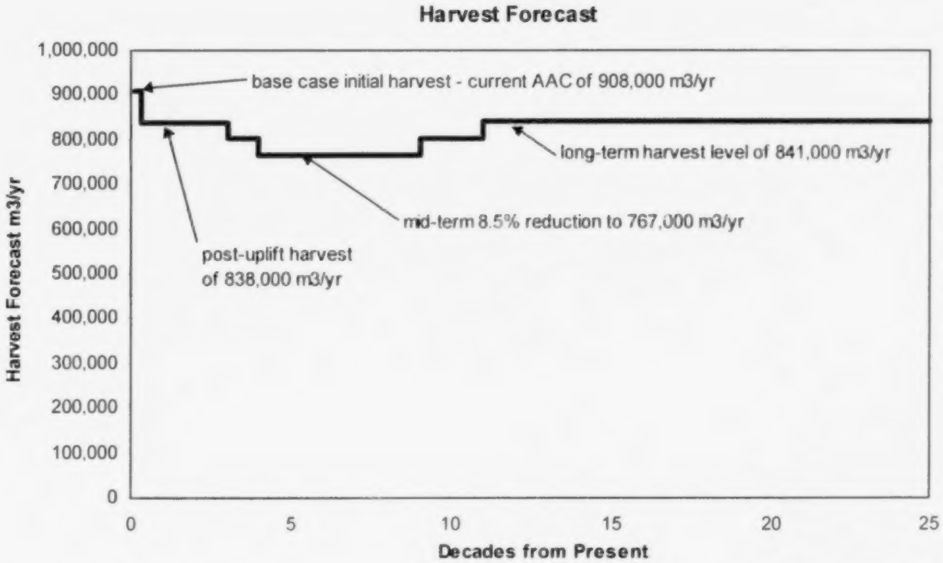

Figure 11. Base case harvest forecast, Cranbrook TSA.

4.3 Base Case Attributes

In order to understand and evaluate the base case harvest forecast, this section describes the stands being harvested over time and the corresponding state of the forest over time. Numerous forest management assumptions have been modeled in the base case analysis, many of which impact the condition of the forest through time. Using the information presented in this section, it is possible to validate these assumptions and review their impact on the overall composition of the forest.

4.3.1 Growing Stock and Timber Availability

Figure 12 shows the total and merchantable timber volumes on the timber harvesting land base throughout the 350 year planning horizon. The total volume represents the volume of all stands containing trees larger than specified minimum tree diameters (i.e., contain trees >12.5 or 17.5 cm dbh depending on species). The merchantable volume is the subset of total volume that comes from stands that are older than their specified minimum harvest age. A flat growing stock curve is desirable because it signals that the rate of harvest roughly equal to the rate of forest growth.

The total current volume on the THLB is over 48 million cubic meters (see Figure 12). Of this total volume, just over 30 million cubic meters is currently of an age that is available for timber harvesting. The volume of merchantable timber rises sharply after 2 decades to 37 million cubic meters as additional stands grow to reach minimum harvest age. Both the total and merchantable growing stock are at their lowest levels at decades 6 and 11, corresponding with the mid-term harvest reduction in the base case harvest forecast in Figure 11. The lowest points of available timber volume occur near decades 6 and 11 and represent the 'pinch points' or most limiting time period in the harvest forecast. The 'pinch point' at decade 6 necessitates the mid-term reduction in the harvest forecast between decades 3 and 10.

After decade 10, both the total and merchantable growing stock rise, and become steady over the long-term. The total growing stock remains steady near 44 million cubic meters, and corresponds with the long-term harvest level in Figure 11. The growing stock is generally flat after decade 12, meaning that the harvest of timber is roughly equal to the growth of timber during this time.

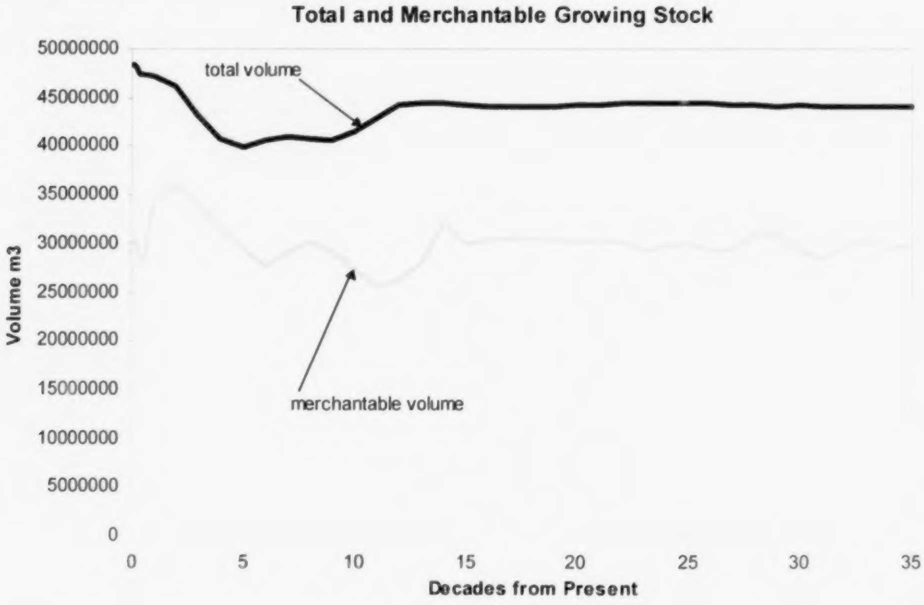

Figure 12 Merchantable and Total Growing Stock on the THLB, Cranbrook TSA base case

Figure 13 below illustrates trends in harvest availability over time and reinforces the point that decade 6 and 11 are the pinch points defining the short-mid term harvest flow in the base case. Figure 13 does not represent a potential harvest flow - it depicts the amount of available harvest volume in each decade, assuming the base case harvest flow was followed for all prior periods (Figure 13 is built from 25 separate runs).

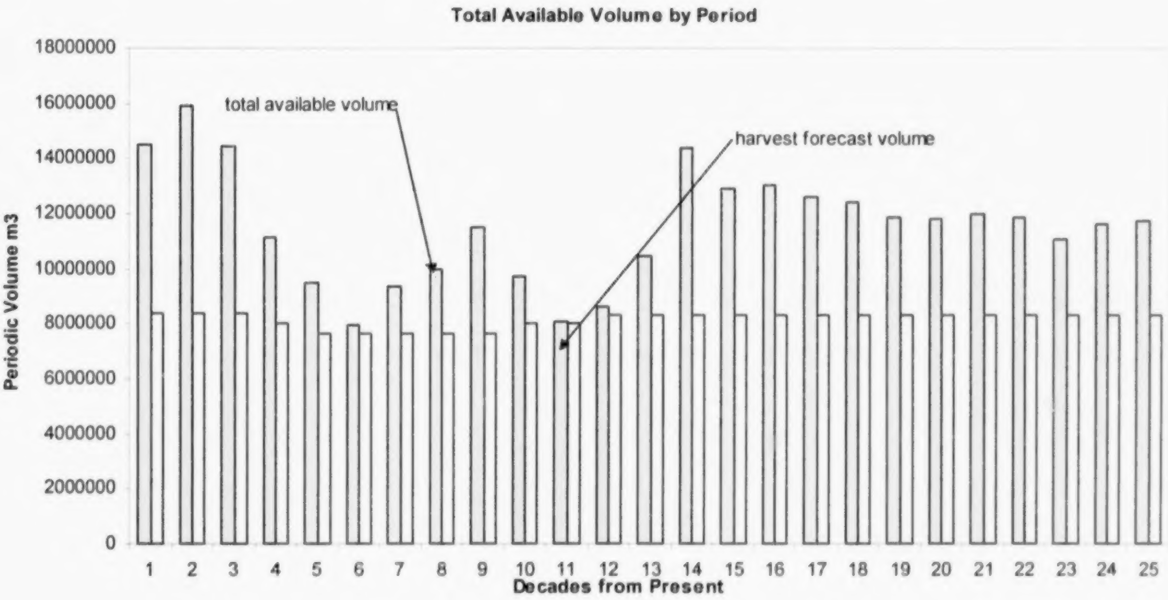

Figure 13. Periodic Volume Available in the Cranbrook TSA

4.3.2 Harvest Attributes

Figure 14 shows the contribution to the base case harvest forecast of both natural and managed stands. In the short-term, the harvest of timber is reliant upon existing natural stands, almost exclusively for 4 decades. After 4 decades, the harvest of natural stands begins to drop sharply as existing managed stands come available for harvest. The transition to managed stands is quite rapid, until the 9th decade, where there is again a large proportion of harvest coming from natural stands. The 9th decade is when the location of old-growth and mature management areas outside the Southern Rocky Mountains Management Plan area are allowed to shift from their original spatial deployment locations to other suitable locations. This results in a spike in the amount of existing natural stands being harvested in this period.

By the 10th decade, the harvest comes almost entirely from managed stands, and the base case harvest forecast transitions up to the long-term harvest level.

The base case harvest forecast has various species and stands contributing to the overall harvest, often at different times. One means of attempting to create a 'realistic' harvest forecast, was to ensure that the harvest in the short-term comes from species and analysis units currently being targeted by forest licensees. The base case model has placed a priority harvest on young pine stands (pine leading stands <110 yrs old) for the first 5 decades of the harvest forecast. In Figure 15 below, the harvest coming from pine leading stands comprises between 60 and 75% of the harvest for the first 3 decades, until merchantable pine stands become more scarce and their contribution to the harvest drops sharply in decades 4 to 7. The high harvest of pine stands in the short-term represents the current practice by forest licensees of targeting these stands for pine beetle management and beetle attack risk reduction.

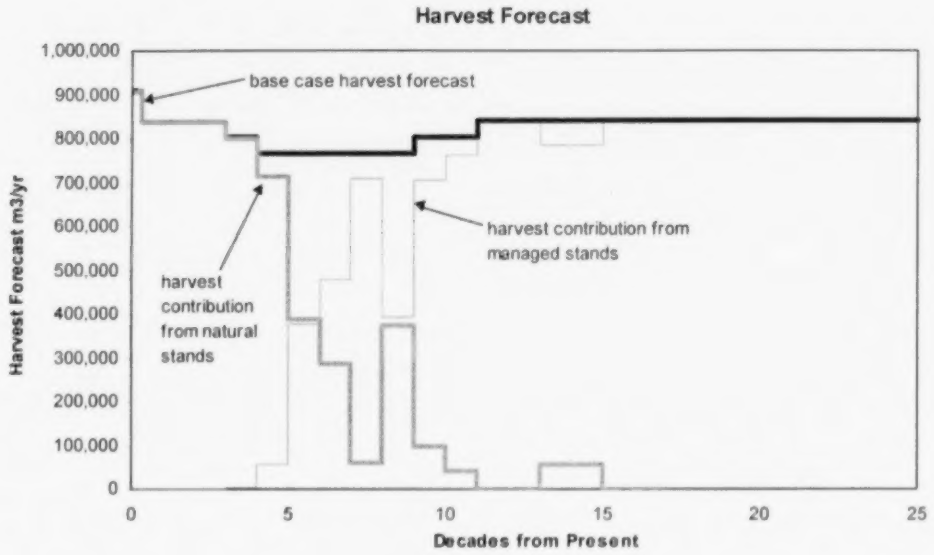

Figure 14. Transitions of Natural Stands to Managed Stands

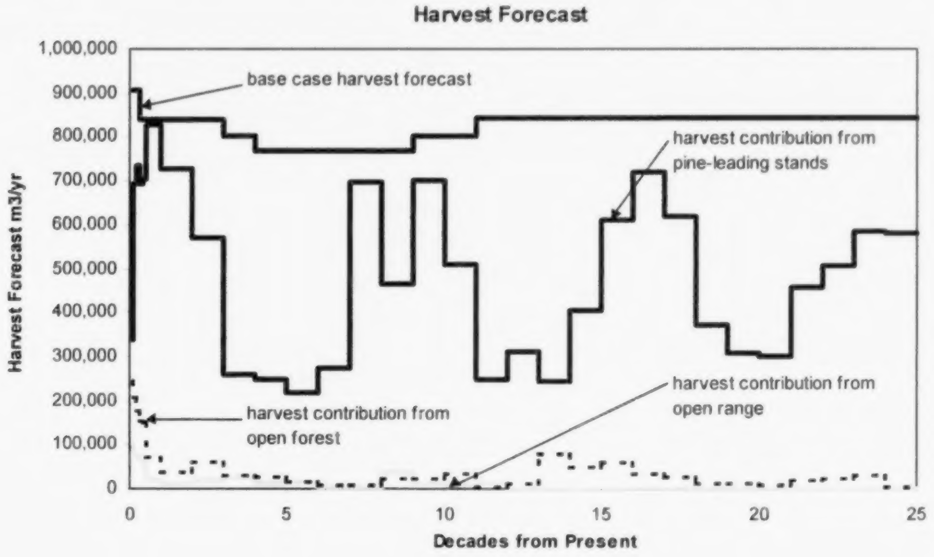

Figure 15. Contribution of pine leading stands, Open Forest and Open Range in the base case

Similarly, open forest and open range stands in the TSA are being targeted by licensees to restore these ecosystems back to a more natural state. The restoration of these dry ecosystems is expected to occur over the next 27 years[2]. In the base case model, the area treated is limited to a maximum of 1251 hectares per year for Open Forest and 585 hectares per year for Open Range (though both seldom achieve this level of harvesting – Open Range forests average 163ha per year of harvesting over the next 30 years). This ensures that their contribution to the overall harvest each year is not greater than what forest licensees are actually anticipated to harvest. Again, Figure 15 shows the volume of harvest that is coming from both Open Forest and Open Range over the next 250 years. Open Forest stands contribute on average 5% to the overall harvest for the 250-year planning horizon. Open Range stands similarly contribute on average about 1.5% to the overall harvest. Most of the harvesting in Open Range is complete by decade 12 since these stands are only entered once for timber harvesting / restoration.

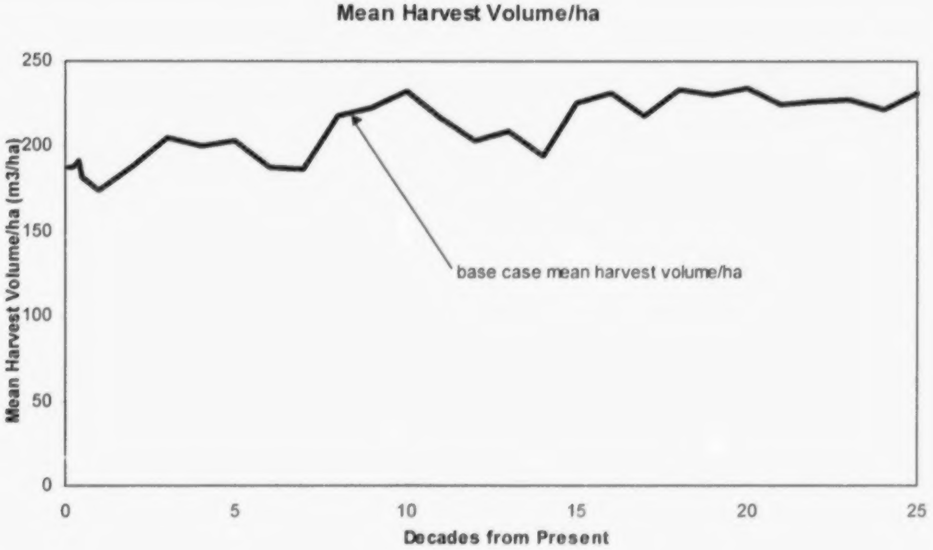

Figure 16. Mean harvest volume per hectare - Cranbrook TSA base case

The mean harvest volume per hectare provides a sense of the types of products that may be derived from timber harvesting, and the costs associated with harvesting. In Figure 16, the mean harvest volume for the base case is shown. The mean harvest volume is at its lowest in the short-term, dropping below 200 m^3/ha in decades 2 and 3 of the harvest forecast. As the harvest transitions to managed stands in decade 10, the mean harvest volume actually increases, and averages 230 m^3/ha from decades 10 to 25. The harvest volume has a sharp increase near decade 9, and is again associated with old and mature retention shifting on the land base, as discussed above.

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[2] As per "A Blueprint for Action", Rocky Mountain Trench Ecosystem Restoration Steering Committee, Feb 2000

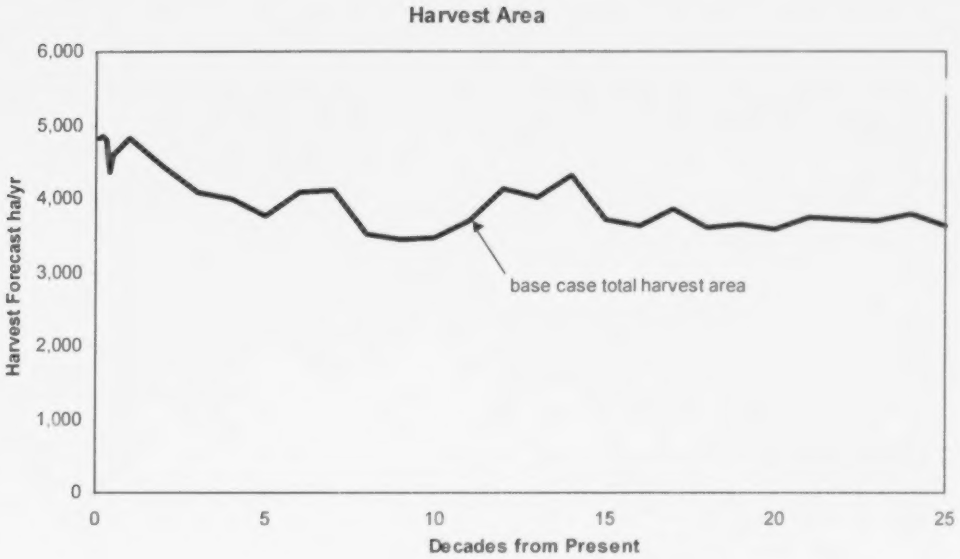

Figure 17. Total harvest area - Cranbrook TSA base case

Total harvest area is generally a mirror image of the harvest volume per hectare. As harvest volume goes up, the harvest area goes down, and vice versa. Figure 17 shows the total harvest area in the TSA (not including the area associated with unsalvaged losses). Harvest area is at its greatest in the short-term, with over 4500 hectares per year harvested in decade 1. From decade 2, the harvest area decreases as harvest volume increases. Between decades 10 and 25, the annual harvest averages 3,798 ha/yr.

Mean harvest age provides an excellent indicator of the type and age of stands harvested over time. The timber harvesting land base is currently dominated by older natural stands, that are being replaced by younger managed stands over the next 100 years. To ensure that the base case model was harvesting from a more 'realistic' profile of stand ages, priorities were placed on younger pine stands, those that are currently being targeted by forest licensees. Figure 18 shows the mean harvest age of the base case analysis. In the immediate future, mean harvest age is nearly 140 years old. This high initial harvest age is primarily due to the salvage of fires (mainly the PlumBob fire) and from the initial harvesting of Open Forest stands – some of which are well above minimum harvest age. The harvest age quickly drops as the harvest comes primarily from younger pine stands for the first 3 decades, averaging 105 yrs. There is a very pronounced increase in harvest age near the 9th decade, again associated with the sudden shifting of OGMA's and MMA's on the land base. Between decades 10 and 25 the harvest age averages 83 years.

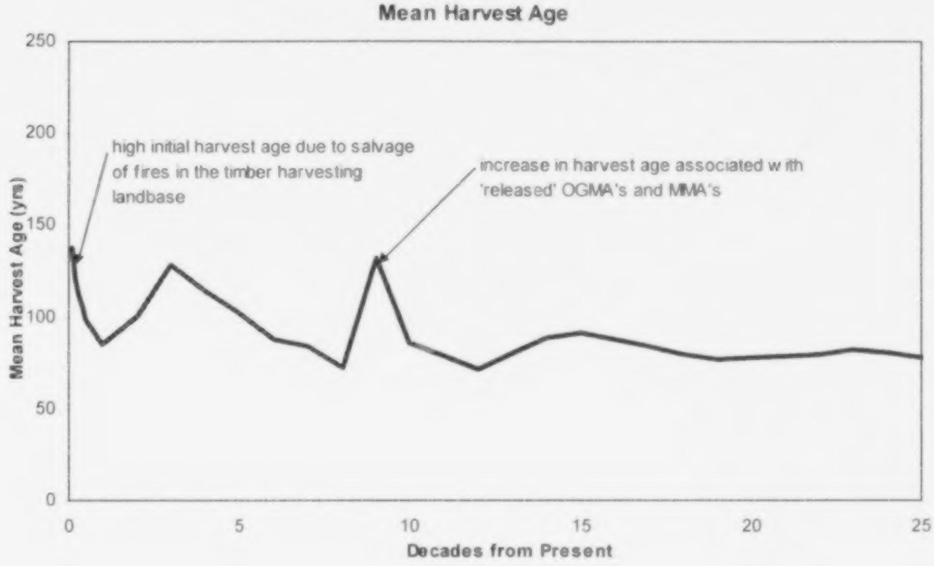

Figure 18. Mean harvest age - Cranbrook TSA base case

4.3.3 Seral Stages

The figures below all provide a view of the changes in seral stage composition on the crown forested land base in the TSA over the next 250 years. The seral stages are shown by natural disturbance type (NDT) and the seral stage definitions come from the *Landscape Unit Planning Guide*. Seral stages are based on stand ages and in general, old seral forests are forests > 140 years old in the case of NDT 3, and are forests > 250 years old for NDT's 2 and 4. In all of these natural disturbance types, a natural disturbance regime has been modelled into the base case to emulate the disturbance of forests outside of the timber harvesting land base. The natural disturbance of non-contributing is described in more detail in section 14.5.1.1.

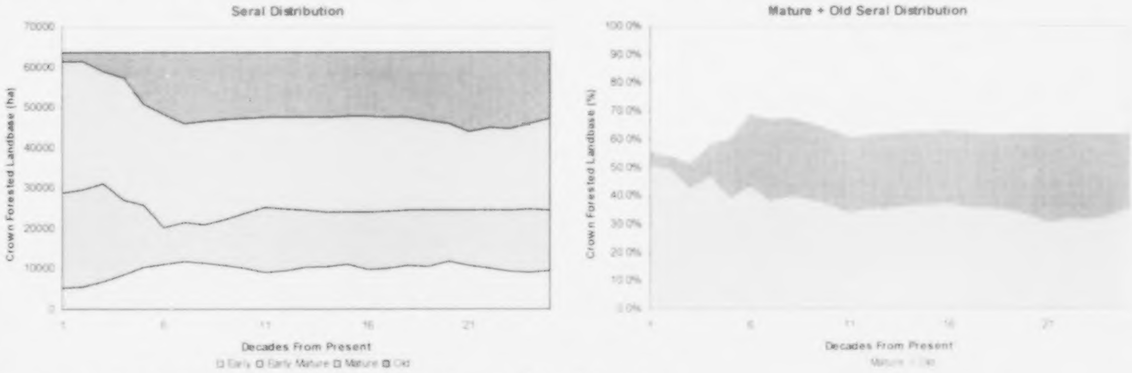

Figure 19. Seral distribution of Natural Disturbance Type 2 forest

NDT 2 forests are generally wetter, higher elevation forests in the Cranbrook TSA and are characterized by infrequent stand replacing disturbances. Only ESSFwm variants fall within this NDT[3] and together they comprise 8% of the CFLB area or 63,600 ha. In the short-term, less than 3% of the NDT 2 forest is currently in an old seral condition (stands > 250 years old) and 51% is currently mature. Over the 250 year planning horizon, the total percentage of forest in old and mature increases from 55% to 61%, and the proportion of area that is old increases significantly from 3% to 25%. NDT 2 forests comprise 8% of the total forest within the TSA.

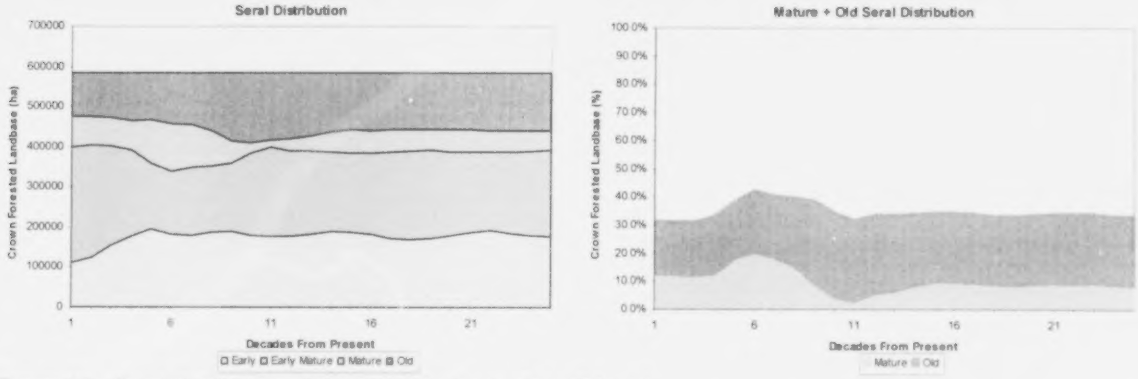

Figure 20. Seral distribution of Natural Disturbance Type 3 forest

NDT 3 forests are drier forests than NDT 2, and are characterized by larger stand replacing disturbances, such as wildfire. Old seral forests are generally forests > 140 years old. NDT 3 forests cover the vast majority (77%) of the Cranbrook TSA CFLB. Old and mature stands in NDT3 are currently 31% of the forest and will increase slightly to 33% of the forest in 250 years. The proportion of stands that are old will also increase slightly from 19% to 24% of the forest by the 25th decade.

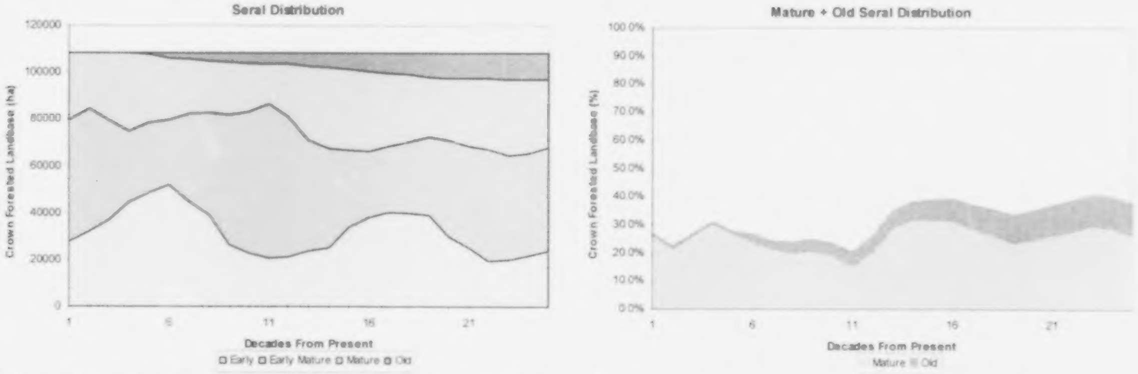

Figure 21. Seral distribution of Natural Disturbance Type 4 forest

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[3] The Biodiversity Guidebook states that ESSF wm variants are considered to be NDT1 north of Crawford Creek and NDT2 south of Crawford Creek. This analysis considered the Cranbrook TSA to be south of Crawford Creek.

NDT 4 forests are the hottest and driest forests in the TSA and are characterized by frequent, natural, stand maintaining disturbances, such as low severity surface fires. Old seral stands are generally stands > 250 years old in NDT 4. NDT 4 currently comprises 15% of the forest in the TSA. Early seral and mid seral stands are collectively 73% of the current NDT4 forest, and there is almost no area in old seral stands. The area of old seral forests is projected to increase steadily over the next 250 yrs to 10% of the NDT 4 forests, while the proportion of mature seral forest will remain near 25% of the total forest.

4.3.4 Meeting Old Seral Objectives

In the base case, old seral constraints were modeled as per the HLPO and provincial policy. In areas assigned a low biodiversity emphasis option (BEO), old seral requirements are allowed to start out at 1/3 of the old seral target and then increase to meet the full target by the end of the third rotation. This is implemented in the model by applying 1/3 of the target in the first rotation, 2/3 of the target in the 2nd rotation, and then the full seral target in the third rotation. By the end of the third rotation, estimated to be 240 years from now, the expectation is that sufficient old seral stands will be on the land base to satisfy full old requirements. The following describes the outcome of this modeling strategy.

Table 5 shows the BEC variants in the TSA, and the time it takes for each BEC Variant to reach its seral objective in the base case. The table shows a time series, by decade, from the 9th decade onward. This corresponds with the time at which the spatially explicit OGMA's are 'released' and broader seral constraints are applied to each zone. For most variants, the old seral target is easily met on or before the 9th decade. This is generally true for NDT 2 variants (ESSFwm for instance) because they typically contain older stands and a high proportion of non-THLB area. NDT 3 variants tend to meet the targets on time because the old seral age of 140 years is easier to achieve. However, many of the NDT 4 variants in the IDF and PP BEC zones do not reach their full targets until the 12th or 13th decades and some variants are not predicted to meet their old seral objective before the end of 25 decades. Notable examples are the IDF dm 2 and the PP dh 2 in several LU's in the TSA. In some of these cases, the required 13% >250 years is never reached in the planning horizon.

Reviewing the table below, there are eleven LU/BEC combinations that do not reach their old seral objective by 250 years. There is 727 ha of ICHdm in the Teepee Creek LU, and the remaining areas are IDFdm2 and PPdh2. The eleven areas together equal over 57000 ha of crown forest, and contain over 88% as THLB. These units are all very highly available to timber harvesting. All eleven of these zones were classified as low biodiversity emphasis option, so the old seral targets were increased over 3 rotations or 240 years. It should be noted that though these eleven zones did not achieve 13% of the forest > 250 after 25 decades, there was 13% of the forest set aside in each of these units, to meet the target, with these units achieving between 9 and 12.8% as >250yrs by year 250. In addition, the model is underestimating the amount of old seral areas in these BEC variants because Open Forest areas are assigned an age of zero after treatment. The residual stands on these sites is likely to contribute toward biodiversity objectives as described in the HLPO.

Table 5. Decades when Old Seral Objectives are met by LU and BEC Variant (shading = target met).

				Decades from Present (dark areas are where old seral objectives are met)																
LU Num	**LU**	**BEC Variant**	**BEO**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
1	Moyie Lake	ESSFdk	I																	
		ESSFdm	I																	
		ICH dm	I																	
		ICH dw	I																	
		ICH mk 1	I																	
		IDF dm 2	I																	
		MS dk	I																	
2	Perry - Moyie	ESSFdk	H																	
		ESSFdku	H																	
		ESSFdm	H																	
		ESSFdmu	H																	
		ICH dm	L																	
		ICH mk 1	L																	
		IDF dm 2	L																	

				Decades from Present (dark areas are where old seral objectives are met)																
LU Num	LU	BEC Variant	BEO	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
		MS dk	L																	
		PP dh 2	L																	
3	Lamb Creek	ESSFdm	I																	
		ICH dm	I																	
		ICH mk 1	I																	
		IDF dm 2	I																	
		MS dk	I																	
4	Hellroaring - Meach	ESSFdk	H																	
		ESSFdku	H																	
		ESSFdm	H																	
		ESSFdmu	H																	
		ESSFwm	H																	
		ESSFwmu	H																	
		ICH dm	H																	
		ICH mk 1	L																	
5	Redding Creek	ESSFwm	I																	
		ESSFwmu	I																	
		ICH dm	I																	
		ICH mk 1	I																	
6	Upper St. Mary's	ESSFwm	I																	
		ESSFwmu	I																	
		ICH dm	I																	
		ICH mk 1	I																	
7	White Creek	ESSFdm	I																	
		ESSFdmu	I																	
		ESSFwm	I																	
		ESSFwmu	I																	
		ICH dm	I																	
		ICH mk 1	I																	
		IDF dm 2	I																	
8	Kimberley Watershed	ESSFdk	I																	
		ESSFdku	I																	
		ESSFdm	I																	
		ESSFdmu	I																	
		ICH dm	I																	
		ICH mk 1	I																	
		IDF dm 2	I																	
		MS dk	I																	
9	Yahk River	ESSFdk	L																	
		ESSFdm	L																	
		ICH dm	L																	
		ICH mk 1	L																	
		MS dk	L																	
10	Bloom - Caven	ESSFdk	L																	
		ESSFdku	L																	
		ICH dm	L																	
		ICH mk 1	L																	
		IDF dm 2	L																	
		MS dk	L																	
11	Teepee Creek	ESSFdk	L																	
		ESSFdku	L																	
		ICH dm	L																	
		ICH mk 1	L																	
		IDF dm 2	L																	
		MS dk	L																	
12	Cranbrook Watershed	ESSFdk	I																	
		ESSFdku	I																	
		IDF dm 2	I																	
		MS dk	I																	
13	Galton Range	ESSFdk	I																	
		ESSFdku	I																	
		IDF dm 2	L																	
		MS dk	L																	
19	Corbin Creek	ESSFdk	L																	
		ESSFdku	L																	
		ESSFwm	L																	
		ESSFwmu	L																	
		MS dk	L																	
20	Alexander - Line	ESSFdk	I																	
		ESSFdku	I																	

				Decades from Present (dark areas are where old seral objectives are met)																
LU Num	**LU**	**BEC Variant**	**BEO**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
		IDF un	I																	
		MS dk	I																	
21	Fording River	ESSFdk	I																	
		ESSFdku	I																	
		MS dk	I																	
22	Upper Elk	ESSFdk	I																	
		ESSFdku	I																	
		MS dk	I																	
28	Galbraith - Dibble	ESSFdk	I																	
		ESSFdku	I																	
		ESSFwm	I																	
		ESSFwmu	I																	
		ICH dm	I																	
		ICH mk 1	I																	
		IDF dm 2	I																	
		MS dk	I																	
29	Wildhorse - Steeples	ESSFdk	I																	
		ESSFdku	I																	
		IDF dm 2	I																	
		MS dk	I																	
30	Cranbrook	ESSFdk	L																	
		ICH mk 1	L																	
		IDF dm 2	L																	
		MS dk	L																	
		PP dh 2	L																	
31	Lost Dog - Mather	ESSFdk	I																	
		ESSFdku	I																	
		IDF dm 2	L																	
		MS dk	L																	
32	St. Mary's Prairie -	MS dk	L																	
		IDF dm 2	L																	
		PP dh 2	L																	
33	Wasa - Picture Valle	IDF dm 2	I																	
		MS dk	L																	
		PP dh 2	I																	
34	Jaffray - Baynes Lak	MS dk	L																	
		IDF dm 2	L																	
		PP dh 2	L																	
35	Tobacco Plains	IDF dm 2	L																	
		PP dh 2	L																	
36	Mayook - Wardner	ESSFdk	I																	
		ESSFdku	I																	
		IDF dm 2	I																	
		MS dk	I																	
		PP dh 2	I																	
37	Linklater - Englishm	ESSFdk	L																	
		ESSFdku	L																	
		IDF dm 2	L																	
		PP dh 2	L																	
		MS dk	L																	
38	East Elk	ESSFdk	L																	
		MS dk	L																	

4.3.5 Age Class Distribution

Figure 22 is a time-series showing the age-class distribution of the TSA's forest in 50 year increments. The present age class distribution shows a significant area of forest between 60 and 90 years of age, on both the THLB and non-contributing land base. A relatively small proportion of the forest is currently greater than 200 years old. As well, the age of non-contributing forest is fairly well distributed among all of the age classes. There is presently very little forest between 20 and 50 years of age on the TSA. This age class gap is the main factor contributing to the mid-term harvest reduction and can be seen in the 50 year snapshot, where very little timber harvesting land base is available in stands greater than 80 years of age.

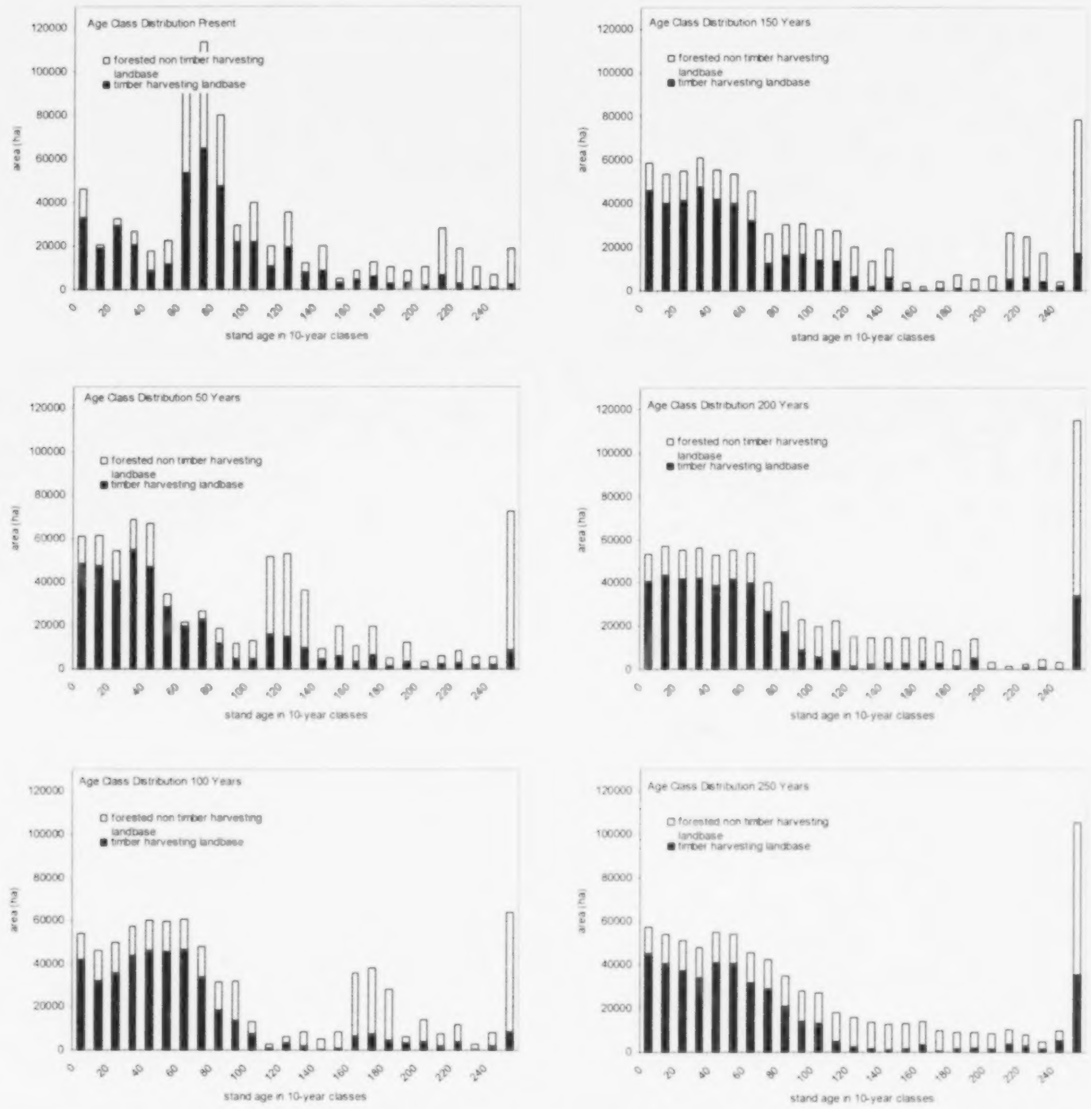


Figure 22. Age Class Composition of the Cranbrook TSA, 2004

The modeling of natural disturbance in the non-THLB leads to the creation of an even distribution of NonTHLB stands through all of the age classes. The 250 year snapshot shows a well-distributed non-contributing land base and a large area of non-contributing that has aged to > 250 years old. Of note as well is that over 35,000 ha of timber harvesting land base has also aged to be greater than 250 years old in the final snapshot. These are areas of timber harvesting land base that are constrained to an extent that timber harvesting is prevented, and represents over 9% of the long-term timber harvesting land base.

4.4 Cover Constraints and Green-Up

In the Base Case analysis, several cover constraints are modeled to ensure that non-timber values are represented on the land base. These constraints address issues related to wildlife habitat, biodiversity, and visual quality and are described in Section 14.0. This section of the report provides a summary of some of the most significant cover constraints modeled in the base case, and how the various constraints are being met over the 250 year planning horizon.

In the KBLUP Ungulate Winter Range areas, constraints are modelled for the species with the greatest cover constraint. In the deep snow zone, 27,000 ha of forest is required to have moose cover constraints of 50%>120 yrs old (therefore 13500 ha > 120 yrs old). In these deep snow moose zones, only 3,400 ha currently meets this criteria, and it is not until the 6th decade that there is sufficient forest > 120 yrs old to meet the moose constraint. From the 6th decade onward, forest > 120 yrs old is maintained at a steady 50% of the zone. See Figure 23. Shown in the figure is the collective result of all zones with a KBLUP deep snow moose constraint, even though the constraint is actually applied and modelled at a more detailed level, within each landscape unit.

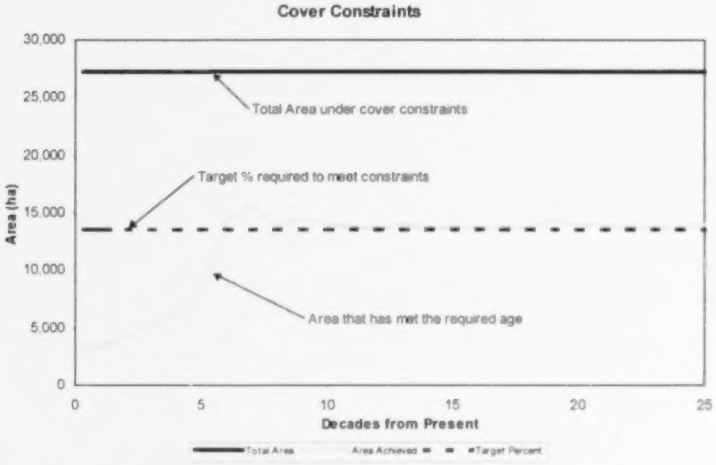


Figure 23. KBLUP Ungulate Winter Range - Deep Snow - Moose - 50% required to be > 120 yrs old

In the KBLUP Ungulate Winter Range shallow snow zone, there are 1,948 ha of forest that are required to have moose cover constraints of 40%>80yrs old (therefore 779ha > 80yrs). In these shallow snow moose zones, only 395 ha currently meets this criteria, but after just 2 decades there is sufficient forest > 80 yrs old to meet the moose constraint. From the 2nd decade onward, forest > 80 years old is maintained at a steady 40% of the shallow snow zone. See Figure 24. This constraint is limiting harvest throughout the planning horizon.

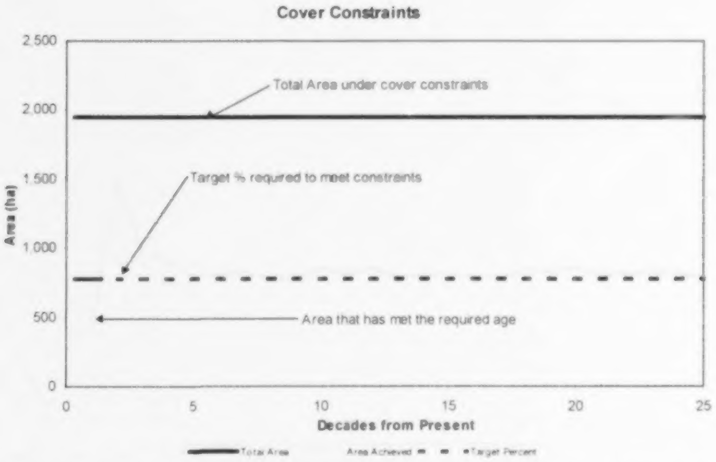


Figure 24. KBLUP Ungulate Winter Range - Shallow Snow - Moose - 40% required to be >80yrs old

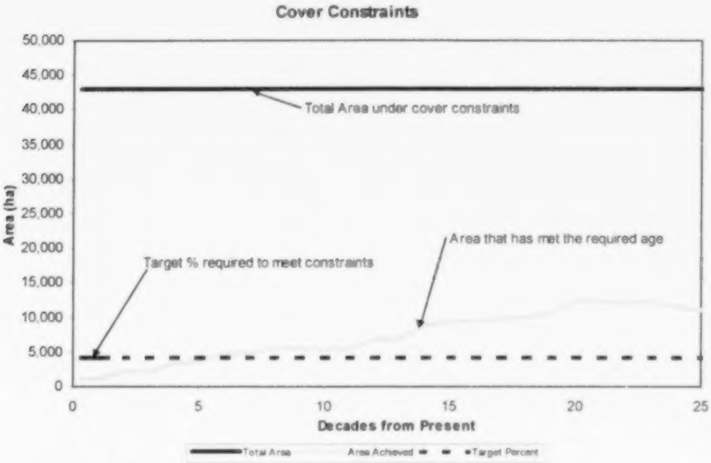


Figure 25 HLPO Caribou - 10% required to be > 250yrs old

In the HLPO caribou zones, below the Caribou Line, 10% of the forest is to be maintained > 250 yrs old. This zone covers 43,000 ha of forest so 4,300 ha needs to be > 250 years old. Not until decade 5 does the area > 250 years meet the target, and then it continues to increase, reaching a maximum of 30% in decade 20. See Figure 25. This constraint is likely only limiting harvest in the very early years of the planning horizon, if at all. It is not limiting because the overlapping mature goal (40%>140) is more constraining and provides the 10% old by default. Except for the old requirement presented here, all caribou constraints are limiting harvest throughout the planning horizon.

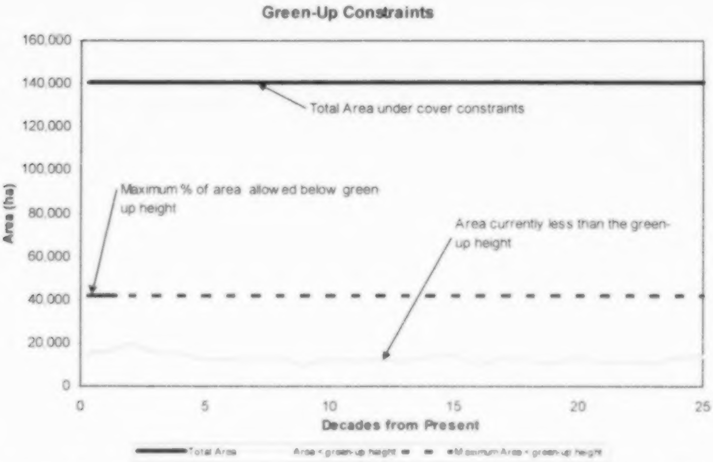
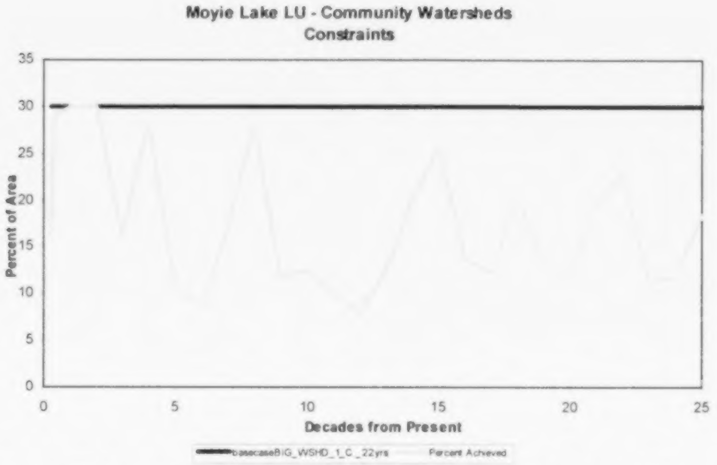


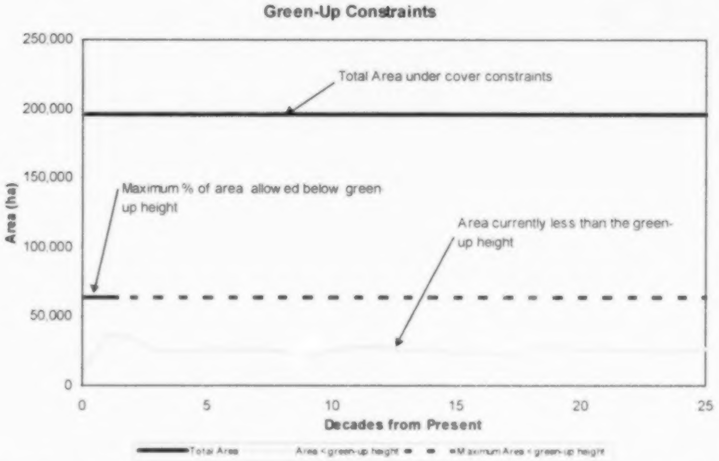
Figure 26. Community and Domestic Watersheds in the Cranbrook TSA - Maximum of 30% < 6m tall

Green-up constraints are different than cover constraints. Cover constraints ensures a specific type/amount of forest remains on the land base. A green-up constraint limits the type/amount of forest that can occur on the land base. In the case of community and domestic watersheds, a maximum of 30% of the forest within the watershed is allowed to be below 6m tall at any one time. Any zone above this maximum means that timber harvesting cannot occur until sufficient area exceeds the 6m green-up. Figure 26 shows the collective sum of green-up area in all watersheds in the TSA. Individual watersheds may be nearer the maximum of 30% at different times. On average however, the total area of watersheds below the 6m green-up is near 10% most of the time, well below the 30% maximum.



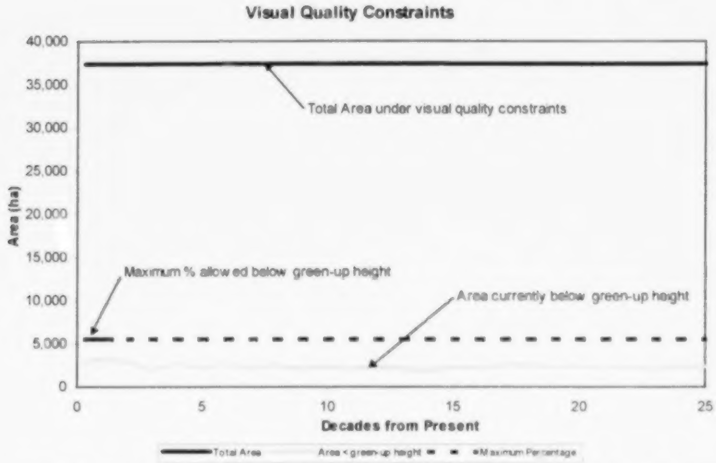
As a comparison to Figure 26, one Community Watershed is shown in this figure. In the Moyie Lake landscape unit, the community watershed does show that in a few instances, the green-up constraint does achieve a maximum of 30% < 6m in a few periods. In decade 2, the constraint is at a maximum. In decades 4 and 8, the percentage < 6m also exceeds 25%. This figure is intended to demonstrate that even though overall green-up constraints can be easily met, in some specific locations around the TSA, green-ups do limit timber harvesting.

Figure 27. Moyie Lake Landscape Unit - Community Watershed Green-Up Constraint - Maximum 30% < 6m



The integrated resource management zone is the area of timber harvesting that is outside of VQO's and outside of the ERDZ. These areas are subject to standard cut-block adjacency and green-up requirements. The IRM green-up constraint is intended to emulate cutblock adjacency and multi-pass harvesting within the model. There are 195,000 ha of THLB subject to the IRM green-up of a maximum of 33% < 2.5m tall. Collectively across the entire zone, approximately 12% or 25,000 ha is less than 2.5m tall at all times. Individual IRM zones within separate landscape units may at times be closer to the maximum percentages.

Figure 28. Integrated Resource Management Zone - Maximum of 33% < 2.5m tall



Visual quality objectives are met by applying a maximum disturbance to VQO polygons in the model. Figure 29 shows the area of VQO's where the maximum disturbance is 15% - which includes some retention, partial retention and modification visual quality zones (see Section 14.2). The sum of these areas, shows that the actual disturbance is generally ½ of the maximum disturbance over the planning horizon. As a comparison, Figure 30 shows a single VQO polygon, where the maximum below green-up does occur in decades 2 and 3, and also exceeds 12% below green-up in decade 20. These VQO green-ups are influenced by the proportion of the VQO that is in the THLB, and the overlap with other constraints, such as UWR. In the case of VQO 540, 43% of the polygon is in the timber harvesting land base.

Figure 29. Visual Quality Constraints for maximum planimetric disturbance of 15% < green-up height

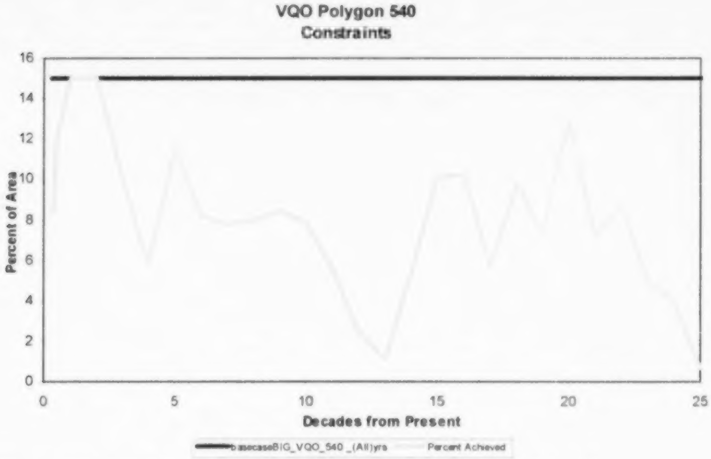


Figure 30. VQO Polygon 540 - Maximum of 15% < 6.5m tall

Figure 29 demonstates that not all VQO polygons are at maximum disturbance levels over the planning horizon. Certain VQO's can be constraining at times through the planning horizon, and more restrictive VQO's, like preservation and retention will be more constraining to timber supply in general. Figure 29 shows only those VQO's where the maximum disturbance is 15%.

How each of these constraints interact to impact timber supply in the Cranbrook TSA is important to understand. The impact that a forest management constraint will have on the TSA level harvest is driven by two main factors; 1) the cover requirement of the constraint, and 2) the area extent of the constraint. For instance, a VQO polygon constraint can limit timber harvesting with a low allowable area of disturbance, such as a maximum of 5% < 7.5m green-up height, but the area of the VQO polygon being managed may be quite small relative to the size of the TSA. Conversely, broad cover constraints, such as the KBLUP Ungulate Winter Range, cover a very large area and can have a greater impact on timber supply due to their size.

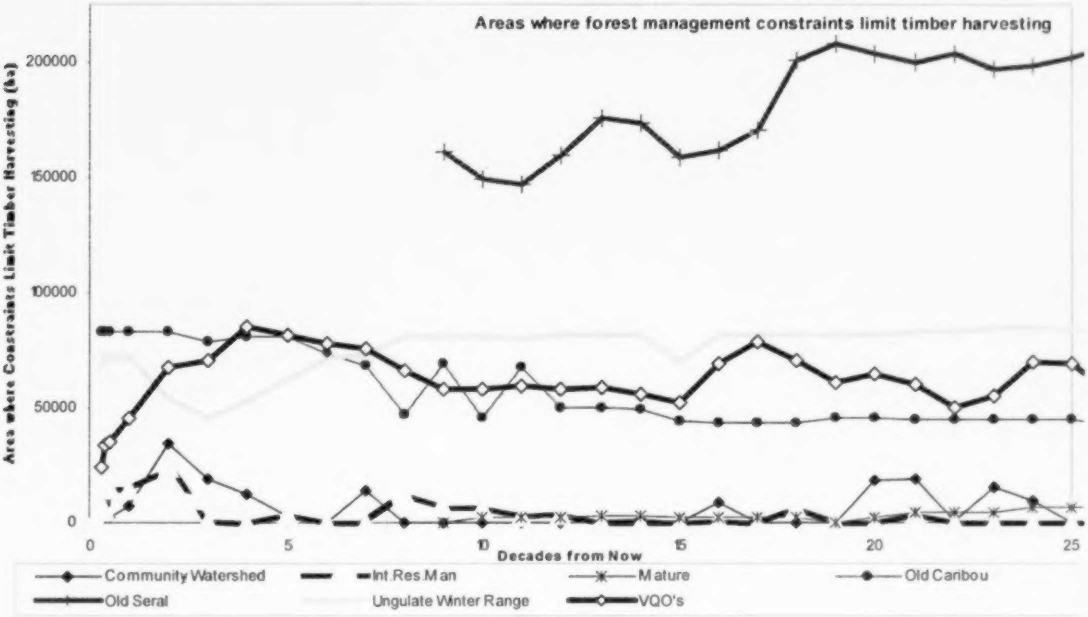


Figure 31. Overview of Constrained Areas within the Cranbrook TSA, base case

Figure 31 above gives a relative sense of the significance of each type of cover constraint in the TSA. Each graphed constraint group is showing the area of the constraint group that is at or near its threshold value (i.e. tight constraints). Tight constraints occur in areas where forest cover conditions have reached maximum or minimum conditions (i.e. a zone has 15% of its area below greenup age and the maximum allowable is 15%). When maximum conditions are met, harvest is prevented from occurring in the group. When minimum conditions are reached (i.e. 10% old is required and 10% or less exists), harvest can still proceed in the remainder of that zone if any eligible stands remain after setting aside the full requirement in the oldest possible stands. However, if minimum constraints are tight, it means that the constraint is actively working to prevent harvest in the % area required – as opposed to the percentage simply being met as a result of some overlapping constraint. This is important to understand if changes to a constraint would translate into changes in harvest availability.

Figure 31 shows over 150,000 ha of forest in the TSA are regularly at or near the minimum amount of old. This area increases so that there is over 200,000 ha of forest meeting the old requirements by the 16th decade. The increase occurs over the planning horizon because harvesting draws down the amount of old stands through time to the minimum level required (i.e. constraint becomes limiting). Thus old seral constraints are actively influencing harvest levels in a large portion of the land base. More areas are not limiting because many of the LU-BEC combinations contain significant areas of NonTHLB forest. A similar circumstance is likely occuring with mature seral goals. In addition, mature seral goals plus they apply on such a small portion of the land base that their overall effect is small.

In the case of Ungulate Winter Range constraints, over 80,000ha of the forest in the TSA is regularly at or near the maximum constraint. VQO's have between 60,000 and 80,000 ha of forest that are close to the maximum green-up constraint between decades 4 and 25. This means that timber harvesting is very minimal in this area of forest, over this time frame.

In general, from Figure 31, old seral, VQO, UWR, and caribou constraints appear to be having the most significant impact on harvest availability in the TSA. The least constraining on the harvest appear to be IRM, mature seral, and community and domestic watersheds.

5.0 Base Case Differences from TSR2

The base case harvest flow presented above falls in-between the published TSR2 base case (maintain the current AAC for 13 decades) and the 'TSR2 Chief Forester's run' (current AAC for 2 decades shown in Figure 10). Since the Chief Forester's Run was more influential in the TSR2 AAC determination, comparisons between the TSR3 base case and TSR2 will be based on the Chief Forester's run.

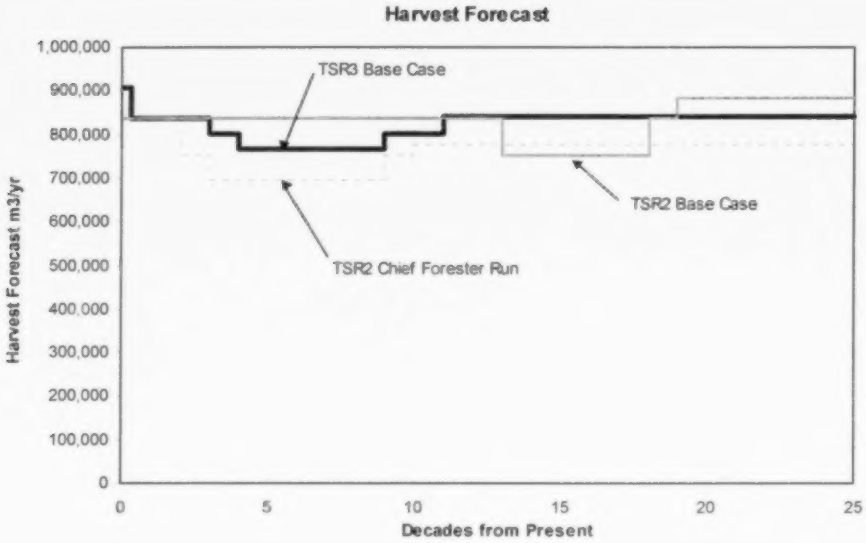


Figure 32. TSR2 and TSR3 harvest forecasts.

Differences between the TSR3 base case and the TSR2 Chief Forester's run are provided below.

Negative Influences on TSR3 base case relative to TSR2

- The current THLB is about 3% smaller than in TSR2. InTSR2, existing trails and landings reductions were incorporated as a volume reduction to the yield tables (worth about 7500ha of timber harvesting land base), whereas in the TSR3 analysis existing trails and landings reductions were incorporated as a land base netdown. With the smaller land base, and logging depletions over the last 5-6 years, the total initial growing stock is about 10% less than in TSR2. The major reduction to the timber harvesting land base came from adjustments to operability, which generally removed higher elevation, low productivity stands from the THLB.
- The Integrated Resource Management Zone green up height is now 2.5m as per HLPO direction. This was modeled as 2m in TSR2.
- HLPO connectivity rules are now embedded in the spatially located OGMAs used in TSR3. This factor was not present in TSR2. TSR3 Sensitivity analysis indicate that this did not impact harvest flows.

Positive Influences on timber supply relative to TSR2

- The broad recreation constraints have not been applied in this TSR (they were in TSR2). It was decided they did not represent current management, but that the netdowns for UREP's, etc. were a better representation of recreation based management.
- The 1% for IWMS has not been applied in TSR3 - but was applied in the TSR2 chief forester run.

- A random harvest rule was not used in TSR3. This was a significant factor in TSR2 in reducing the number of decades that the current AAC could be maintained and reducing the long-term harvest level. The Chief Forester's rationale stated that the harvest was not necessarily random and not necessarily oldest first. The TSR3 base case has applied an absolute oldest first harvest rule in conjunction with harvest priorities on young pine stands that is meant to reflect what is currently happening in the TSA. The goal is to achieve a short-term mean harvest age in the analysis that is consistent with current practice (~110 yrs).
- In the TSR2 Chief Forester's run, seral constraints were applied as per the previous KBLUP HLPO - which required that mature seral constraints were applied in all LU/BEC/BEO combinations. Since then, the HLPO has been revised and mature seral constraints only apply in a portion of 7 landscape units. The reduced area with mature seral constraints is likely to increase timber supply relative to TSR2.
- The PEM-based UWR is modeled in the SRMMP area now, instead of the KBLUP UWR constraints. This PEM based UWR is generally less constraining than the KBLUP UWR.
- The use of select seed in future managed stands has increased the long-term harvest level by about 5% and extended the duration of the current AAC by one decade.
- Regeneration delays for analysis units have decreased by about 1-2 years.
- In community and domestic watersheds, the green up height is now modeled as 6m (instead of 9m), reducing the constraint on timber harvesting.
- VQO constraints and green up ages in this analysis were generated individually for each VQO, based on slope and viewing distance - so the green up ages for VQO's vary up and down from the single ages used in TSR2.

Similar influence on timber supply relative to TSR2

- OGMA's and Mature Management Areas (MMA's) are spatially defined in TSR3 for the first 8 decades of the analysis.
- There are numerous other differences between TSR2 and TSR3 as listed in Section 3.6 but they either have no impact or their impact is inclear.

6.0 Timber Supply Sensitivity Analyses

The data and assumptions used in timber supply analysis are often subject to uncertainty. To provide a perspective on the impacts on timber supply of uncertainty in the data or assumptions, sensitivity analysis is commonly performed. Usually only one variable (data or assumption) used in the base case is changed in order to explore the sensitivity of that variable. Sensitivity analysis is a key component of any Timber Supply Review process. Sensitivity analysis permits the determinant (the Chief Forester) to gauge the potential impact of uncertainty around assumptions and data that make up the base case. Sensitivity analyses help to frame the potential impacts of uncertainty by analyzing scenarios that are more pessimistic and more optimistic than the base case.

Selecting the sensitivities to run within the analysis is important, since the sensitivities need to be relevant to the management unit and meaningful to the determination. In this TSR, the sensitivities listed below were selected since they represented the range of issues that are critical to the Cranbrook TSA and are critical to explore in this analysis to provide perspective to the Chief Forester for the AAC determination.

Table 6. Completed Sensitivity Analyses

Sensitivity analysis	**Zone/ group / analysis unit subject to uncertainty**	**Description of Analysis**
Size of Timber Harvesting Land base	Timber Harvesting Land Base (THLB)	The timber harvesting land base will be increased and decreased by +/– 10%.
Managed Stand Yields	Managed Stands	The volume associated with managed stands will be increased and decreased by +/- 10%
Natural Stand Yields	Natural Stands	The volume associated with natural stands will be increased and decreased by +/- 10%
Open Range / Open Forest Yields	OR/OF AU's	Reduce the volume contribution from OR/OF stands to zero to assess importance of these areas to timber supply. Decrease the volume from subsequent OF entries by 50% to explore possibility of reduced yeilds associated with the production of range values.
Site Productivity	Managed Stands	Adjust managed stand site indexes using SIBEC methodology and East Kootenay PEM data. Site index changes effect yields, minimum harvest ages and green-up ages.
Minimum Harvest Ages	All Stands	Minimum Harvest ages will be increased and decreased by +/- 10 years.
Harvest Priorities	Timber Harvesting Land Base (THLB)	Replace the Oldest First harvest rule with Random and Relative Oldest First.
Ungulate Winter Range	Wildlife	The new ungulate winter range (PEM based) will be modeled outside of the SRMMP.
Caribou	Wildlife	The new caribou strategy based on habitat type will be modeled.
Use of Select Seed	Future Managed Stands	Apply no gains and full (2013) gains of select seed to future managed stands.
Regen Delays	Future Managed Stands	Increase regen delays to 3 years for clearcut AU's. Fd/PY, OR, OF regen delays would remain at 10yrs.
OGMAs	Crown Forested Land Base	Seral goals applied from time zero instead of spatial OGMAs/MMA's outside the SRMMP. (Test of connectivity requirement in HLPO)
Mountain Pine Beetle	Pl Stands >60yrs	50% of susceptible Pl stands (>60yrs, >50% Pl, nonESSF) dead by year 10. Anything not salvaged in 10 years is naturally regenerated (VDYP) with a 20yr (total) regen delay. Pine harvest capped at 90% of annual cut.
2003 Fires	Fire stands not salvage logged	70% of the unsalvaged fire areas drop out of the THLB because they regenerate to problem forest types..

6.1 Size of Timber Harvesting Land Base

Several factors that determination of the size of the THLB have uncertainty around their definition (operable area, problem types, low sites, riparian management, impacts from trails and landings, etc). Different market conditions in the future or changes in harvesting or milling technology can also serve to reduce or expand the land base considered to be economic.

The timber harvesting land base in the Cranbrook TSA has decreased by 3% (18,538 ha) since the last timber supply review. The largest factor has been the review of timber harvesting operability for the TSA, which revealed that there were fewer hectares available for timber harvesting in the TSA. Changes in how terrain stability is netted from the land base have also had upward pressures on the size of the timber harvesting. Uncertainty in the size of the land base can also be influenced by other land base factors such as the total area of problem forest types, the minimum thresholds for low site stands, and the size of road and riparian buffers used in the GIS data preparation.

It is not known whether the THLB used in this analysis has been over- or under-estimated, so two sensitivity runs have been completed. These runs increase and decrease the size of the THLB by 10%.

How was it Analyzed?

Run	How was it Analyzed?
Timber harvesting land base + 10%	The modeled size of each THLB polygon in the timber harvesting land base was increased by 10% to a total of 457,185 ha.
Timber harvesting land base - 10%	The modeled size of each THLB polygon in the timber harvesting land base was decreased by 10% to a total of 374,566 ha.

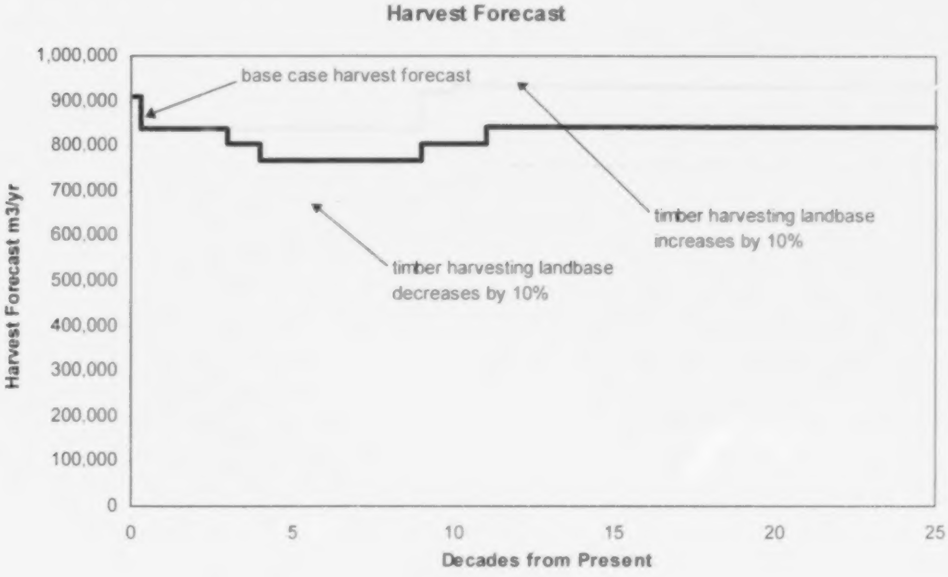


Figure 33. Timber Harvesting land base increased and decreased by 10%

Results

Run	Short-term	Mid Term	Long-term
Timber Harvesting Land Base + 10%	The pre-uplift AAC of 838,000 m3/yr is maintained for 9 decades.	No drop in harvest during the mid-term.	Increase in the long-term harvest level of 10.9% to 933,000 m3/yr.
Timber Harvesting Land Base - 10%	The current AAC is maintained for only a decade, and the harvest drops to 678,000 m3/yr by the 3rd decade.	The mid-term harvest of 678,000 m3/yr is 11% below the base case.	Long-term harvest level is 10.2% below the base case at 755,000 m3/yr.

6.2 Yields from Natural and Managed Stands

Stand yields are a critical input into timber supply analysis. The short and mid-term timber supply is very much influenced by the availability of timber in natural stands that make up the current growing stock. The currently mature timber provides short-term timber harvesting opportunities before managed stands come available for harvest. Figure 14 indicates that the supply of natural stands diminishes very quickly by the 5th decade, at which time managed stands become more important to the timber harvest profile. The timing and amount of managed stand volume has a large impact on the mid and long-term harvest forecast.

Uncertainty in timber yields can result from many different factors. Natural stand yields are based on the VDYP yield model, which estimates yields from the stand attributes in forest inventory maps. Inaccuracies in the model, in decay estimates, or stand attributes can create uncertainties in the actual stand yields. An inventory audit of the TSA completed in the late 1990's concluded that the inventory of the TSA was over-estimated by up to 4.2%, though the difference was not statistically significant.

Managed stand yields are based on the TIPSY growth model, which is derives its yields from estimates of site index, the attributes of managed stands (species, density, gains from select seed, etc). TIPSY also requires adjustment factors that reduce optimal yeilds down to operational yields. These adjustments address such things as endemic forest health losses, decay/waste/breakage, gaps in the stand, non commercial species in the stand, etc. The over or under estimation of any of these factors can lead to uncertainties in the yields of these future stands.

How was it Analyzed?

Run	How was it Analyzed?
Natural Stands + 10%	The yield of each natural stand analysis unit was increased by 10%.
Natural Stands - 10%	The yield of each natural stand analysis unit was decreased by 10%.
Managed Stands + 10%	The yield of each existing managed and future managed stand analysis unit was increased by 10%.
Managed Stands - 10%	The yield of each existing managed and future managed stand analysis unit was decreased by 10%.

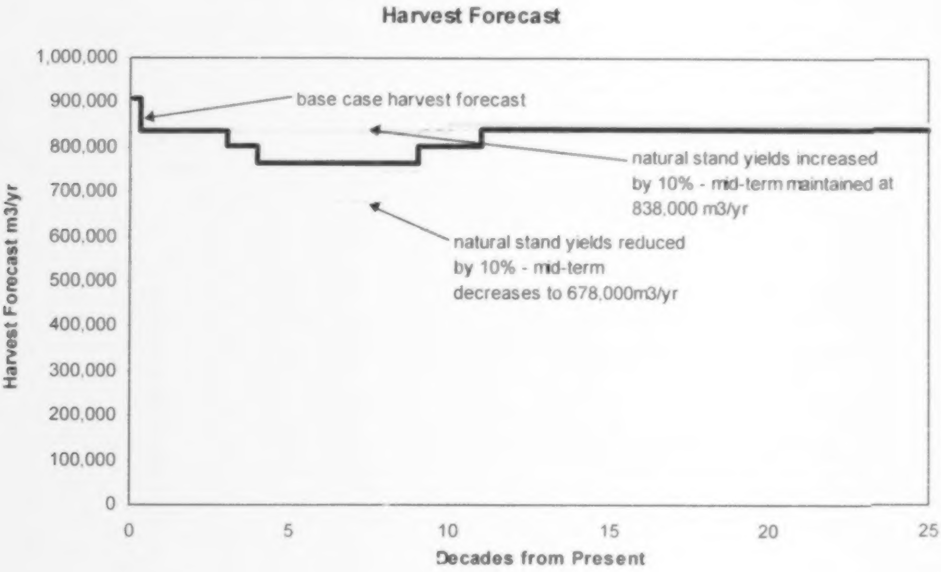


Figure 34. Natural stand yields increased and decreased by 10%

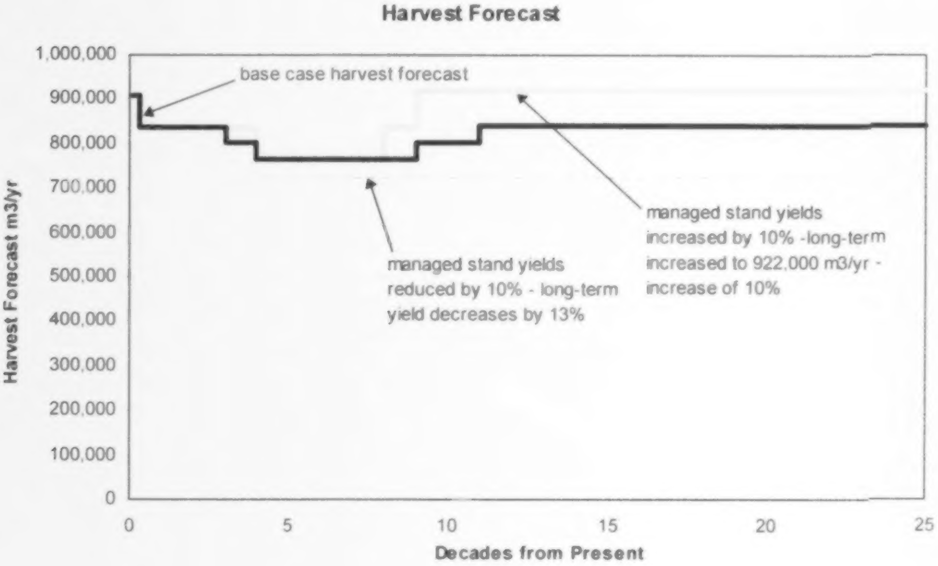


Figure 35. Managed stand yields increased and decreased by 10%

Results

Run	Short-term	Mid Term	Long-term
Natural Stands + 10%	The pre-uplift AAC of 838,000 m3/yr is maintained for 9 decades.	No drop in harvest during the mid-term.	Increase in the long-term harvest level of 1.4% to 853,000 m3/yr.
Natural Stands - 10%	The current AAC is maintained for only a decade, and the harvest drops to 678,000 m3/yr by the 3rd decade.	The mid-term harvest of 678,000 m3/yr is 11% below the base case.	No change.
Managed Stands + 10%	No change	The current AAC is maintained until the 4th decade.	An increase of 10% to 922,000 m3/yr.
Managed Stands - 10%	No change	Harvest decrease to 723,000 m3/yr by the 5th decade, and remains at that level.	The long-term harvest level is 13% below the base case at 723,000 m3/yr.

6.3 Yields from Open Range / Open Forest Yields

In the hot, dry Rocky Mountain Trench, decades of wildfire fire-suppression have lead to overly dense stands on sites that historically provided Open Forest and Open Range conditions. Restoration of these sites is occurring when forest licensees and/or BCTS enter these stands and reduce the stand density, and when Provincial Government Agencies, stakeholders and/or Non-Governmental Agencies carry out ecosystem restoration treatments (thinning, slashing, and/or burning). As discussed earlier, the THLB area associated with Open Range (19,383 ha) and Open Forest (42,092 ha) is significant (14.8%) and contributes an average of 6.5% to the overall harvest forecast in the base case.

These restoration treatments can be economically marginal and stands may not be harvested if timber prices are too low, or the timber products are unsuitable for existing markets. In addition, management treatments for Open Forest areas are expected to provide a significant contribution to range habitat (50%) and thus volumes from subsequent harvests are somewhat uncertain. The base case assumes that roughly half of the regular natural stand (VDYP) volume will be available at subsequent Open Forest entries. Sensitivity analyses have been run to examine both of these issues. The first takes a worst case scenario approach and assumes that all OR/OF sites are uneconomical to log and no volume is realized from their treatment. The second examines the impacts of reducing the volume expectation from subsequent Open Forest harvests to 25% of regular natural stand (VDYP) yields.

How was it Analyzed?

Run	How was it Analyzed?
Open Range and Open Forest no yield	No harvest was permitted from either Open Range or Open Forest analysis units.
Open Forest Future Entry Yields decreased by 50%	The yield of analysis unit 251 was cut in half.

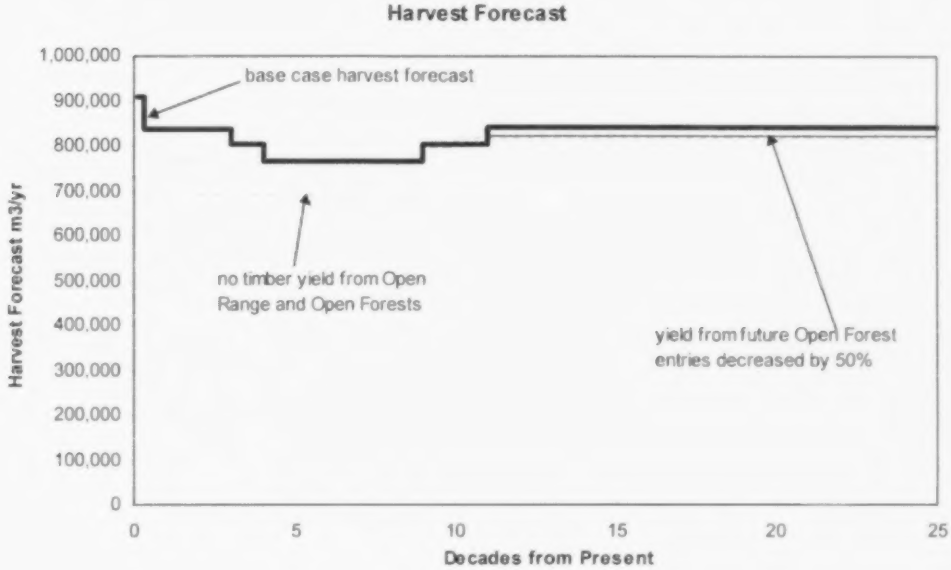


Figure 36. Changes in yields to Open Forest and Open Range

Results

Run	Short-term	Mid Term	Long-term
Open Range and Open Forest no yield	The pre-uplift AAC of 838,000 m3/yr is maintained for only 1 decade before decreasing to 690,000 m3/yr, 19% below the base case.	Mid-term harvest is 690,000 m3/yr, 10% below the base case.	Decrease in the long-term harvest level of 2.7% to 818,000 m3/yr.
Open Forest Future Entry Yields decrease by 50%	No change.	No change.	Decrease of 2.1% in the long-term harvest, to 823,000 m3/yr.

Though the Open Forest and Open Range stands only contribute an average of 6.5% to the overall harvest forecast, these stands are important for maintaining the short and mid-term harvest levels. The impact of removing these stands from the harvest is less significant to the long-term harvest.

6.4 Minimum Harvest Ages

Uncertainty around the age that stands become merchantable for harvest is linked to both our ability to predict the future growth of stands and our ability to understand future conditions that will define merchantability (markets / products). The large majority of minimum harvest ages used in the base case scenario were based on achieving 95% of the stands maximum mean annual increment (MAI). This age almost always delivered the minimum stand and log requirements (vol/ha, avg dbh) but these criteria occasionally pushed the harvest ages higher. It is important to note that minimum harvest ages are only meant to approximate the time when a stand first becomes merchantable, and that harvesting can and does occur well beyond these ages in the model.

The use of minimum harvest ages associated with maximum MAI's tends to optimize long-term harvest levels but the use of younger ages tends to provide flexibility in the transition from short-term to long-term harvest levels. The transition from short to midterm harvest levels in the Cranbrook TSA is heavily influenced by when managed stand volumes become available in significant quantities. It is unknown if there are more appropriate minimum harvest ages than those used in the base case, so sensitivity runs have been completed to explore the impact of both higher and lower ages.

How was it Analyzed?

Run	How was it Analyzed?
Minimum Harvest Ages Increased by 10 years	In all analysis units, the minimum harvest age was increased by 10 years.
Minimum Harvest Ages Decreased by 10 years	In all analysis units, the minimum harvest age was decreased by 10 years.

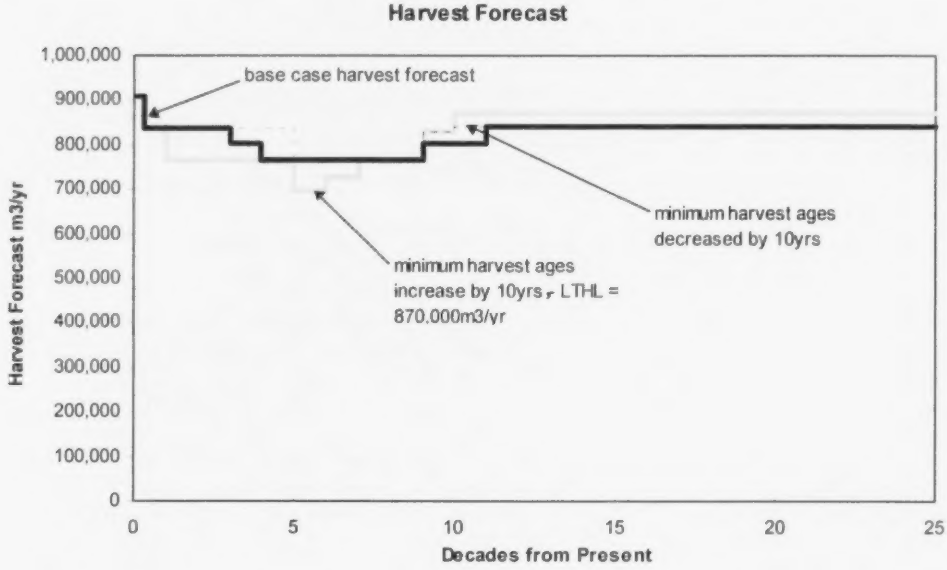


Figure 37. Minimum harvest ages increased and decreased by 10 years

Results

Run	Short-term	Mid Term	Long-term
Minimum Harvest Ages Increased by 10 years	The pre-uplift AAC of 838,000 m3/yr is maintained for only 1 decade before decreasing to 767,000 m3/yr, 8.5% below the base case.	Mid-term harvest decreases as low as 697,000 m3/yr, 9% below the base case.	Increase in the long-term harvest level of 3.4% to 870,000 m3/yr.
Minimum Harvest Ages Decreased by 10 years	No change.	The current AAC can be maintained until the 5th decade before decreasing.	No change.

The base case forecast is very sensitive to increases in minimum harvest ages because it delays the availability of managed stands beyond the 5th period. Thus, existing natural stands must be metered out over a longer time frame using a lower short-term harvest level. However, the longer minimum harvest ages result in stands being harvested closer to their maximum MAI and therefore a 3.4% gain in the long-term harvest level is realized. Decreases in the minimum harvest ages result in some additional flexibility in the transition from short to mid term harvest levels because more managed stand volume is available earlier. This flexibility does not appear to have impacted long-term harvest levels relative to the base case.

Figure 38 shows that the difference in growing stock that occurs when harvest ages are increased by 10 years. Merchantable volume is lower than in the base case by 26% (22.8 million cubic meters vs 30+ million cubic meters) thus short-term availability is reduced.

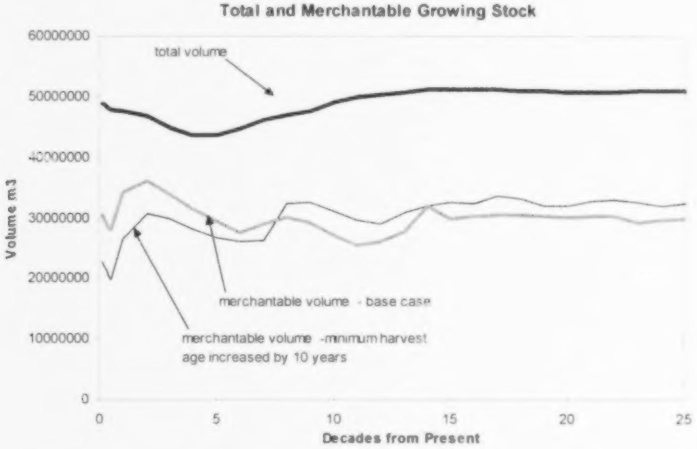


Figure 38. Merchantable growing stock when Minimum Harvest Age is increased by 10 years

6.5 Harvest Rules and Harvest Priorities

Harvest priorities help to establish the order in which stands will be scheduled for harvest by the model. The goal is to have the model harvest stands in a manner that is consistent with current management. The District Manager's most recent direction to licensees was to prioritize harvesting as follows: salvage/dead timber, susceptible beetle stands, fire maintained ecosystem restoration treatments, and finally available old stands. With numerous recent pressures from bark beetle infestation and fires, licensees are not typically harvesting the oldest stands on the land base. This was recognized in the base case by prioritizing 2003 fire salvage, then pine stands susceptible to beetle attack, then Open Range/Open Forest stands (to a cap), and then finally an absolute-oldest-first priority on the remaining stands.

A sensitivity that examines changes in the harvest rule examines the impact of altering the modeled harvest rule from absolute-oldest-first, to relative-oldest-first, and to random. A relative oldest first rule will evaluate stand age relative to a stands minimum harvest age. Stands furthest from their minimum harvest age would have the highest priority for harvest.

How was it Analyzed?

Run	How was it Analyzed?
Random Harvest Rule	In the timber supply model – the harvest rule was changed to random from absolute oldest first. All preceding priorities remained the same.
Relative Oldest First Harvest Rule	In the timber supply model – the harvest rule was changed to relative oldest first from absolute oldest first. All preceding priorities remained the same.

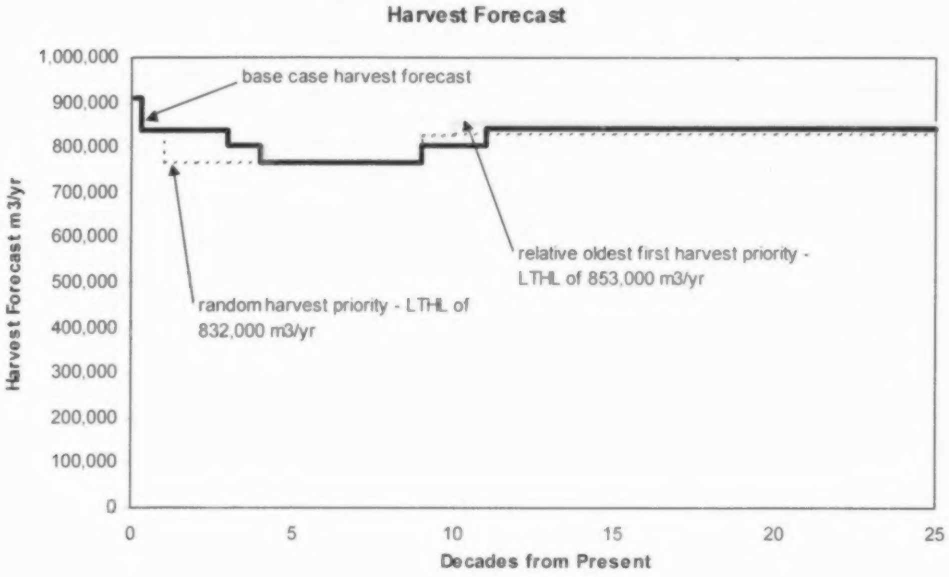


Figure 39. Random and relative oldest first harvest priorities

Results

Run	Short-term	Mid Term	Long-term
Random Harvest Rule	The pre-uplift AAC of 838,000 m3/yr is maintained for only 1 decade before decreasing to 767,000 m3/yr, 8.4% below the base case.	No change.	Decrease in the long-term harvest level of 1.1% to 832,000 m3/yr.
Relative Oldest First Harvest Rule	No change.	No change.	Step up to the long-term harvest level one decade earlier. Harvest level is 1.4% higher.

A random harvest rule decreases both the short-term and long-term harvest level. Decreases occur because slower growing older stands are not converted as quickly into fast growing managed stands. A relative oldest first harvest rule has the opposite effect, and makes a more optimal use of stand growth. The result is a slight increase in the long-term harvest. The differences seen here would likley be greater if the other harvest priorities (fire salavge, young pine, OR/OF) were not used. This layered set of priorities servers to mitigate the impact of changes to the base harvest priority.

Both TSR2 and this sensitivity analysis indicate that Cranbrook short and midterm harvest levels are sensitive to the random selection of stands for harvest. The magnitude of this sensitivity is lower in TSR3, likely because the layered harvest priorities (fire salvage, young pine, etc) make the base case in TSR2 less 'optimal' than the pure relative-oldest-first run priority used in TSR2 base case. The chief forester's run shown in Figure 10 utilized a random harvest rule.

6.6 Site Productivity Estimates

Throughout the province, it has been recognized that existing inventory site indexes often do not adequately reflect the potential stand growth experienced by second growth, managed stands. Current site productivity estimates are based on the existing inventory of natural stands - stand ages and heights are used to derive site indexes for each stand. In the Cranbrook TSA, species such as Pl, Lw, Fd, and Sx have issues such as suppression, repression, and height growth damage that can result in site index underestimation in natural stands. In addition, the significant areas of partially cut stands and uneven aged stands in the inventory have the potential to result in less accurate site index estimates. Many of these stands are assigned a single age and height in the inventory that may not always correlate well with site productivity estimates.

In an effort to understand the potential impact of applying an ecologically based site index adjustment in Cranbrook, a sensitivity run was completed where all managed stand curves were built using site indexes adjusted based on ecological relationships (SIBEC). This site index adjustment was not included in the base case scenario because the accuracy of the underlying ecosystem map (East Kooetnay PEM) is unknown. This PEM was created to support the development of the new ecosystem based ungulate winter range guidelines and is the basis behind the sensitivity run that looks at those new guidelines. The PEM is recognized as a relatively coarse product.

The adjustment process increased the average site index on the THLB from 16.2m to 18.1m (1.9m or 11.7% increase). The gains by BEC variant can be seen in Figure 40 and come mainly from adjustments in the ESSFdk, MSdk, and ICHmk1, and IDFdm2. The majority of the area adjusted in these BEC variants was based on second approximation SIBEC estimates.

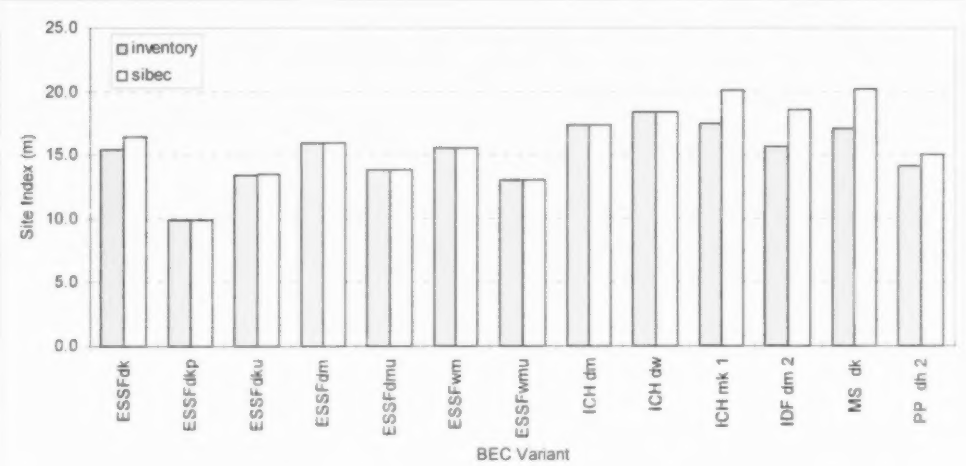


Figure 40 . Inventory and SIBEC adjusted average site indexes by BEC variant

How was it analyzed?

This sensitivity examines the changes in harvest forecast that can arise form changes to estimates in site productivity.

Run	How was it Analyzed?
SIBEC Adjusted Site Indexes	The East Kootenay PEM was used to derive new site index estimates for the TSA based on provincial SIBEC relationships. The new site indexes were used to derive changes to future stand yields (new TIPSY yields), changes to green-up ages and changes to minimum harvest ages.

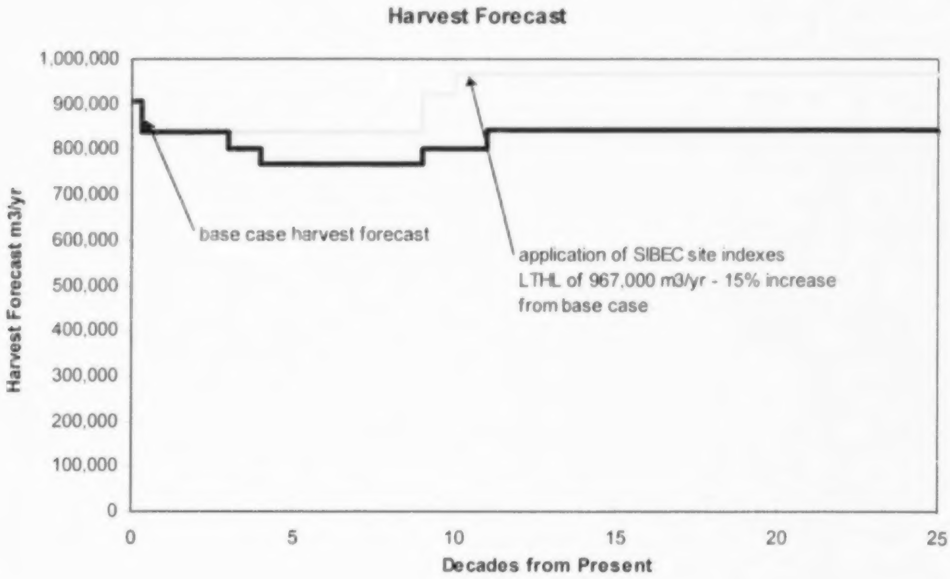


Figure 41. Changes to site productivity estimates with SIBEC.

Results

Run	Short-term	Mid Term	Long-term
SIBEC Estimates	No change.	Current AAC is maintained through the mid-term, so mid-term is 9.3% greater than the base case.	Increase in the long-term harvest level by 15% to 967,000 m3/yr.

Changes in site-productivity estimates have a very dramatic influence on the harvest forecast. The yields of future stands are available earlier because of reduced minimum harvest ages and/or volume yields are greater. Figure 42 below shows how the merchantable growing stock increases, making more volume available and filling in 'pinch points' near decades 6 and 11. The faster growth of stands also means that green-up heights are achieved sooner.

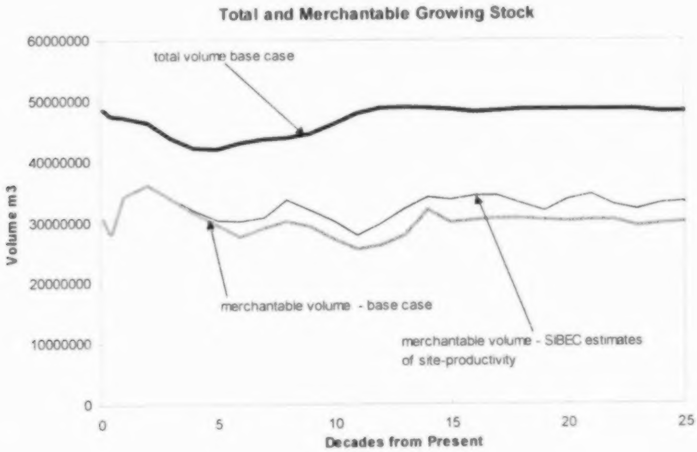


Figure 42. Merchantable growing stock with SIBEC changes to site productivity.

6.7 New Ungulate Winter Range Guidelines

Following TSR 2, a committee was struck to examine UWR management practices in the East Kootenay. The committee developed an ecosystem based management strategy for UWR management with objectives for both landscape and stand level management. The committee's UWR mapping is based on habitat types derived from a coarse Predictive Ecosystem Map (PEM). Habitat types were defined based on site series and management objectives are provided for each habitat type (i.e. Open Forest, Open Range, and Managed Forest units defined by moisture regimes). These new objectives are intended to replace the KBLUP Ungulate Winter Range practices that were modeled in the base case.

How was it Analyzed?

Run	How was it Analyzed?
PEM Based Ungulate Winter Range	KBLUP UWR objectives were removed and the new habitat zones and associated cover constraints were implemented (see below for detail). *Application of forest cover requirements*: The modeled cover requirements were consistent with the new UWR mapping and guidelines except where retention was to be modeled around avalanche tracks (no data available). The areas designated as OR/OR in the PEM based mapping did not have any cover constraints applied. The area of Managed Forest in the PEM based mapping (118,433 ha of THLB) did have cover constraints applied (refer to section 14.4.1 for detail). *Yields:* Yields and Analysis Unit assignments remained unaltered from the base except future yields associated with Open Forest management were reduced by 50% to reflect lower minimum stocking requirements aimed at improving range habitat. The base case identified OR/OF stands using mapping built from 50% ecosystem restoration mapping and 50% TSR2 algorithm derived mapping. The new UWR mapping specifies different locations and extents of OR/OF/MF areas relative to the base case and the yield implications of this were not captured in this sensitivity. If the PEM based designations for OR/OF were used to redo Analysis Unit assignments, the net result would be a 6302 ha increase in OR area and a 473 ha decrease in OF area. This includes shifts in area between the OR/OF/MF designations. As an example, the new UWR-OR currently consists of 35% OR, 56% OF, and 9% MF as designated in the base case. The new UWR-OF consists of 17% OR, 43% OF, 39% MF as designated in the base case. The new UWR-MF consists of 3% OR, 8% OF, and 89% MF as designated in the base case.

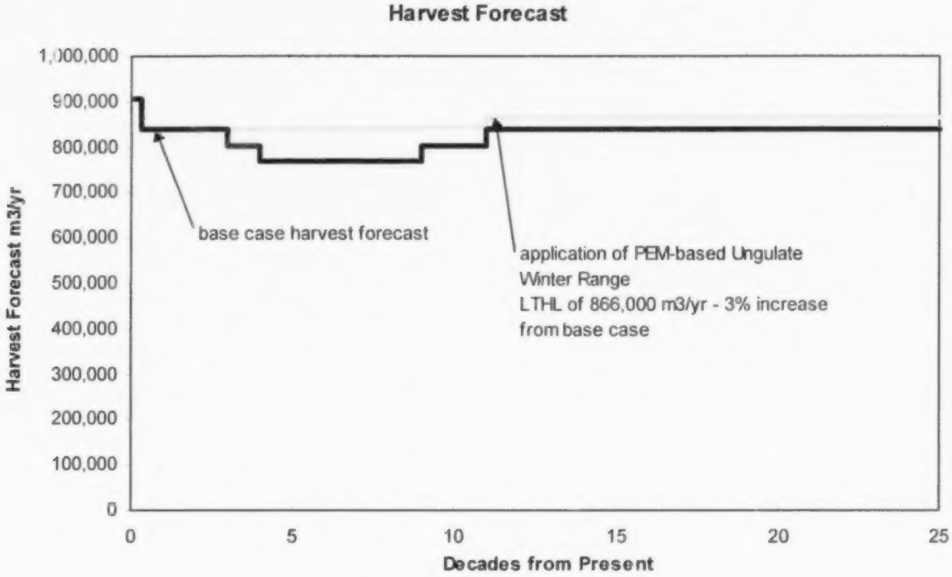


Figure 43. Application of PEM-based Ungulate Winter Range Management

Results

Run	Short-term	Mid Term	Long-term
SIBEC Estimates	No change.	Current AAC is maintained through the mid-term, so mid-term is 9.3% greater than the base case.	Increase in the long-term harvest level by 3% to 866,000 m3/yr.

The new UWR management guidelines cover more THLB area (184,023 ha vs 157071 ha) but forest cover constraints apply to 48,312 fewer CFLB ha (24% reduction) and 38,628 fewer THLB ha (25% reduction). In addition, forest cover requirements are significantly less constraining in drier ecosystems in recognition that forage is more of a concern than snow interception cover in these areas. See Section 14.4.1 for more details. This has increased the flow of available timber through the mid-term, eliminating the trough, and increasing the long-term harvest level. This projection slightly overestimates the long term harvest flow associated with the new UWR guidelines because the retention requirements around avalanche tracks were not modeled and the reduced yields associated with the proposed expansion of open range areas was not modelled. This is anticipated to reduce the long-term harvest level by <1% and have minimal impact in the short and mid term.

6.8 New Caribou Management Guidelines

Section 3 of the Kootenay Boundary Higher Level Plan Order specifies caribou habitat management guidelines to be applied in a number of zones within mapped caribou habitat. The forest cover requirements associated with these zones can be found in Table 64 and was modeled in the Base Case.

New caribou guidelines based on habitat types have recently been completed and can be found in Table 65. These guidelines define more specific habitat zones and also use leading tree species to determine the forest cover constraint that is to be applied. In general, the new guidelines are more restrictive above the 'caribou-line' and in stand types other than Pl,Fd and Lw. There are almost no restrictions on the harvesting of Pl,Fd and Lw stands below the 'caribou-line'. An HLPO amendment to include these new caribou guidelines is currently in progress and will likely be completed by the time of AAC determination.

How was it Analyzed?

Run	How was it Analyzed?
New caribou habitat objectives	The KBLUP caribou objectives were removed and the new habitat zones and cover constraints were implemented. Leading tree species in combination with the mapped habitat zones defined the final constraint groups in FSSIM.

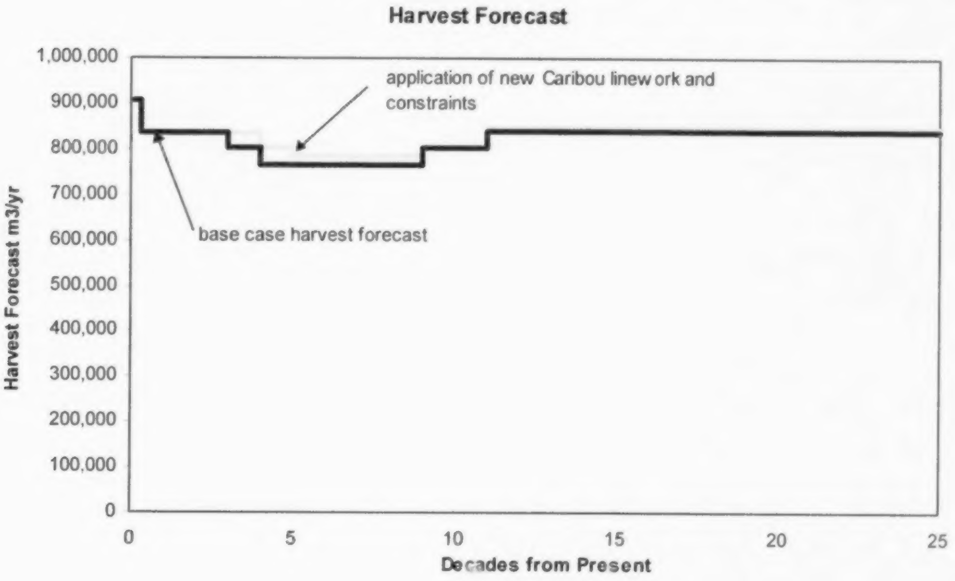


Figure 44. Application of new caribou management guidelines and mapping

Results

Run	Short-term	Mid-term	Long-term
New Caribou Objectives	No change.	Current AAC harvest can be maintained for one decade longer than seen in the base case. The midterm level trough is also 2.1% shallower than the base case.	Increase in the long-term harvest level by 0.8% to 848,000 m3/yr.

The new caribou guidelines increase timber availability in the mid and longterm relative to the base case. Although the guidelines impact 22,028 fewer hectares in the CFLB (35% reduction) and 21,003 fewer ha in the THLB (64% reduction) the area that remains under constraint is almost entirely locked out of harvesting. Approximately 88% of the THLB under the new caribou constraints completely exclude harvesting, while the remaining 12% have signficant forest cover requirements applied. The reduction in area comes primarily from the removal of Pl, Fd, and Lw leadings stands from the identified habitat zones.

6.9 Gains From the Use of Select Seed

As required by the Forest Practices Code, the TSA uses the best genetic quality seed and vegetative material available for regeneration. The use of select seed from tree breeding programs for regeneration increases expected future volume yields. TIPSY yields for future managed stands were adjusted in the base case relative to past and current use of select seed. (existing increases for Lw-1% and Sx-3%, future increases for Lw-6%, Pl-1% and Sx-17%). Ongoing breeding programs in seed orchards are expected to continue to improve the quality of this select seed and deliver even higher gains than the seed planted today.

The sensitivities shown below examine the impact of using the projected 2013 gains for all future managed stands (Fd-5%, 2%-Pl, 14%-Lw and 19%-Sx), and the impact of eliminating all gains from select seed. The later run is completed to understand the risks associated with under performance or lack of availability in select seed.

How was it Analyzed?

Run	How was it Analyzed?
2013 gains from select seed	The expected gains for 2013 seed were applied to yield tables. As in the base case, area weighted average gains were applied to all occurrences of a species (Fd-5%, Pl-2%, Lw-14%, Sx-19% applied in TIPSY).
No gains from select seed	All gains from the use of select seed were removed from the base case yield tables.

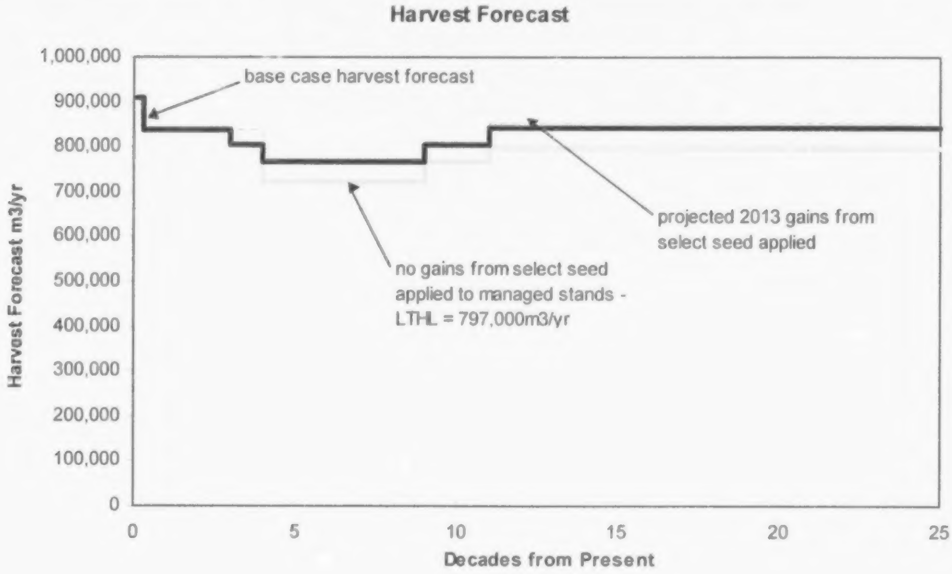


Figure 45. Volumes Gains Associated with the use of Select Seed

Results

Run	Short-term	Mid Term	Long-term
2013 gains from select seed	One additional decade at the current AAC is possible, for a total of 4 decades.	No change	Increase in the long-term harvest level by 1.4% to 853,000 m3/yr.
No gains from select seed	No Change.	The mid-term harvest decreases to a low of 722,000 m3/yr by the 4th decade, 5.9% below the base case.	Decrease of the long-term harvest level of 5.2% to 797,000 m3/yr.

The volume gains in the base case associated with the use of select seed helps timber availability in the midterm and improves the long-term harvest level. When these gains are completely removed, the midterm trough is 5.9% deeper than in the base case and the long-term is 5.2% lower. When projected future (2013) gains for select seed are modelled, marginal improvements in the mid- and long-term forecasts occur. A larger improvement was not seen because the AU's experiencing significant increases (Fd & Lw) only represent about 20% of the THLB. Significant improvements in harvest flow would occur if the gains associated with lodgepole pine increased and sufficient select seed was made available to the TSA.

6.10 Regeneration Delays

Regeneration delay is the length of time between timber harvesting and stand re-establishment. Regeneration delays can be important to harvest forecasts since they impact the length of time that it takes to meet greenup requirements and the time between harvest rotations. The trend in the TSA has been toward shorter regeneration delays because licensees are planting sites quickly after harvest and relying less on natural regeneration. In the base case, all stands outside the Open Forest, Open Range, and Fd/Py shelterwood AU's are assume to have a 1-year regeneration delay on average. This sensitivity examines the risk of it taking longer than 1 year on average to establish new stands in the TSA.

How was it analyzed?

Run	How was it Analyzed?
Increased regeneration delays	Analysis units with a 1 year regen delay in the base case were changed to 3 years. In the OF, OR, and FdPy analysis units, the regeneration delay was maintained at 10 years to reflect the challenges associated with natural regeneration in these hotter, drier analysis units.

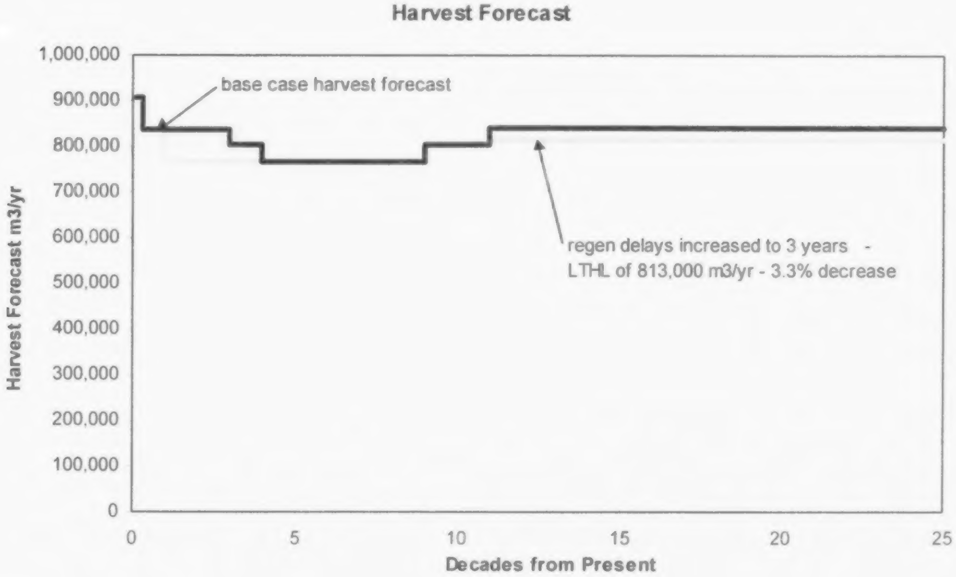


Figure 46. Changes in regeneration delays

Results

Run	Short-term	Mid Term	Long-term
Increased Regeneration Delays	Current AAC is maintained for only 1 decade before decreasing 8.5% to 767,000 m3/yr.	The mid-term dip in the harvest forecast is longer in duration, from decade 2 to 10.	The long-term decreased by 3.3% to 813,000 m3/yr.

The length of time that it takes to establish a new stand after timber harvesting is significant to maintaining the base case harvest forecast. Delaying the availability of midterm stands by 2 years and lengthening the time it takes stands to reach greenup heights results in less volume available in the midterm. To fill in this midterm gap, short-term volume must be sacrificed. The long-term harvest level decreases because rotation lengths are 2 years longer (avg. of 2.5% longer) with no additional volume created and constraints are met more slowly.

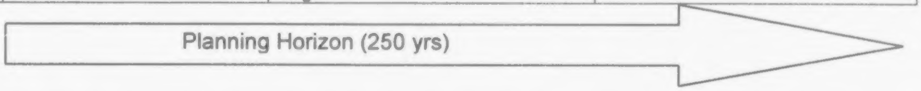
6.11 OGMA/MMA Modeling

In the base case, spatially explicit Old Growth Management Areas and Mature Management Areas were used to meet landscape level objectives for old seral and mature forests for the first 80 years. In the Southern Rocky Mountain Management Plan area, OGMA's and MMA's had already been defined and established as government policy. Outside the SRMMP, a GIS exercise was used to select OGMA's and MMA's (up to required target areas) based on a priority sequence derived by the MSRM planner in the East Kootenays (Tom Volkers). Whenever possible, these selections integrated previous OGMA planning work that had been completed in several of the LU's outside of the SRMMP area.

A spatially explicit approach to modeling the HLPO old and mature forest objectives in the base case was used because it allowed full recognition of connectivity requirements and the operational realities around pine beetle management in the TSA. The following table describes how old and mature seral goals were modeled over time.

Table 7. Time sequence of old and mature seral modeling in the base case

Area of TSA	**First 80 Years**	**81-160 Years in Future**	**161+ yrs into future.**
Southern Rocky Mountain Mgmt Plan (LU's 14-18, 23-27)	Prevented harvest of SRMMP Old and Mature retention areas. (no seral constraints on)	Prevent harvest of SRMMP Old and Mature retention areas. Apply old seral constraints to Low BEO areas using 2/3 target.	Prevent harvest of SRMMP Old and Mature retention areas. Increase requirement on Low BEO areas to full target.
Remainder of TSA (see Table 70 for a description of how spatially explicit OGMA's and MMA's are being created)	Prevented harvest of script generated old and mature retention areas. (no seral constraints on)	Release retention areas and apply seral constraints by LU and BEC for both old and mature requirements. Low BEO areas use 2/3 old seral target.	Maintain seral requirements already established but increase requirement on Low BEO areas to full target.



The application of seral goals at year 80 reflects the expectation that OGMA's and MMA's are not static and will move around the landscape over time. However, because of the formal status, the SRMMP OGMAs and MMA's were not allowed to move – they were excluded from harvest for the duration of the planning horizon.

The transition to seral goals was done at year 80 because it corresponded with an increase from one-third to two-thirds target requirements in Low Biodiversity Emphasis Option areas.

To examine the impact that spatially explicit OGMA/MMA's may be having in this analysis, a sensitivity run was completed where no spatial OGMA/MMAs were used outside of the SRMMP area and seral constraints were applied from time zero. The approach used in the SRMMP area was not altered from the base case. This run will help to answer the question of impact associated with the HLPO connectivity requirements.

How was it analyzed?

Run	How was it Analyzed?
Remove Spatially explicit OGMA's and MMA's	No changes were modeled in the SRMMP area. Outside of the SRMMP area, no spatial OGMA or MMA's were modeled. Seral constraints for old and mature seral retention were set up for each LU-BEC variant. In low BEO areas, the old seral objective began at 1/3 target, then increased to 2/3 by 80 years, and to the full target by 160 years.

Results

Run	Short-term	Mid Term	Long-term
Remove Spatially explicit OGMA's and MMA's	No Change	No change	No change

There was no change in the harvest forecast as a result of replacing the spatial old and mature retention (outside SRMMP) with seral constraints. The connectivity rules in the HLPO do force more retention into the THLB so a change was expected – however, MSRM's OGMA/MMA allocation rules did not use pine leading stands in the THLB because of concerns with mountain pine beetle attack. This appears to have effectively offset any extra THLB retention required by connectivity rules in the HLPO

The most notable change in this sensitivity run are the mean harvest ages over time. Figure 47 shows the mean harvest ages over time for both the base case and the seral constraint sensitivity run. The sharp increase in harvest ages in the 9th decade, associated with 'releasing' the OGMA's in the base case, is not apparent in the sensitivity analysis. The harvest of these older stands is simply spread into earlier periods, raising the mean harvest age for the seral constraint run in these periods.

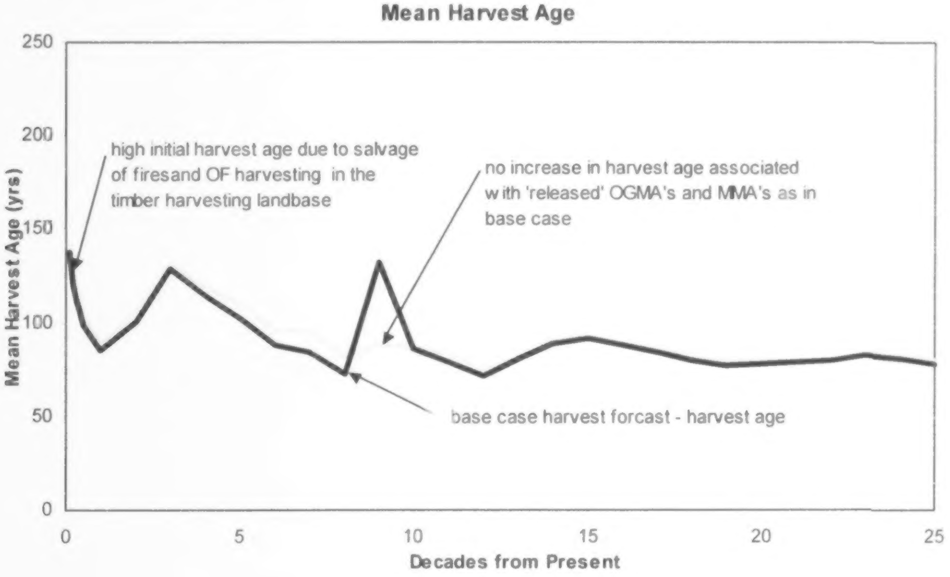


Figure 47. Mean harvest age when spatially explicit OGMA's and MMA not used in analysis

6.12 Mountain Pine Beetle Infestation

The base case analysis includes a high harvest priority on young pine stands in order to emulate current practices around mountain pine beetle issues in the TSA. Current practices are attempting to control beetle populations and salvage mortality where it occurs. The 2003/4 beetle survey data show that populations are expanding quickly and could cause significantly mortality if they are not held in check by management practices and/or environmental factors. This sensitivity is designed to explore the implications of a very large outbreak occurring and causing significant mortality in the TSA. The outbreak is assumed to kill 50% of the susceptible pine stands in the TSA in the next 10 years. Susceptible pine stands are consider to be >60 yrs old and not in the ESSF biogeoclimatic zone.

Pine-leading stands make up over 45.1% of the THLB in the TSA and susceptible pine stands make up 28.6% (119,040 ha) of the THLB at year 10. Thus, an area of 59,520 ha of susceptible pine stands are killed in the first 10 years of this sensitivity analysis. This results in a level of mortality beyond what licensees can salvage in a timely manner, and thus a large volume of timber is lost.

How was it analyzed?

Run	How was it Analyzed?
Mountain Pine Beetle Outbreak	After 1 decade (10 years from now), one half of all susceptible pine stands in the THLB (59,520 ha) are assumed to be beetle-killed and require salvage. This area was picked randomly from the susceptible stands and then placed on a separate set of analysis units with a high harvest priority applied. Salvage of these stands is allowed to continue for 10 years and any unsalvaged stands existing at the end of 20 years were transferred back to natural stand yield curves and all volume was lost. Salvaged stands had a 1 year regeneration delay, while unsalvaged stands had a 20-year (total) regeneration delay. The amount of Pl harvested in any period was limited to 90% to reflect mill requirements.

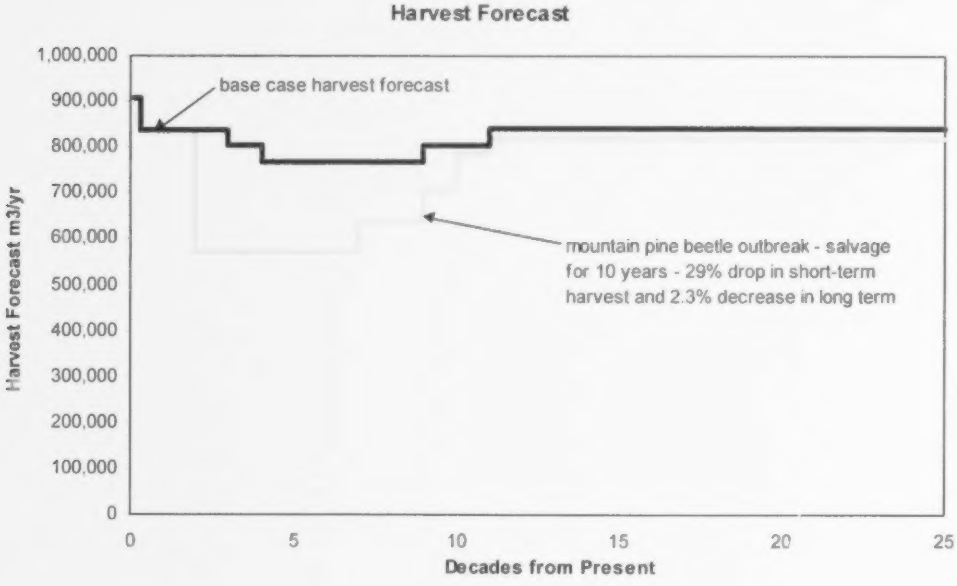


Figure 48 Mountain Pine Beetle Outbreak - one possible scenario

Results

Run	Short-term	Mid Term	Long-term
Mountain Pine Beetle Outbreak	After the 2nd decade, the harvest drops by 29% to 573,000m3/yr.	Still 25% below the base case in the 5th decade. Harvest begins to climb up to the long-term level in period 7.	The long-term harvest climbs back up to be only 2.3% below the base case.

Of the 59,520 ha of pine leading stands killed at year 10, 29,900 ha were salvaged in decade 2. This left over 29,620 ha of pine stands dead and unsalvaged (volume loss of ~6,520,000). This represents 7% of the timber harvesting land base that reverts to a young age, creating an age class gap and greatly decreasing the volume of merchantable timber available. This leads to a sharp drop (29%) in harvest level in the 3rd decade and a much lower trough than occurred in the base case. An increased level of salvage during the second decade would not have altered the future harvest flow, but it would have captured more of the 6+ million m3 that was lost at the end of the 2nd decade.

6.13 Regeneration in 2003 Fires

The fires of 2003 impacted considerable area in the Cranbrook TSA (22,434 ha of CFLB, 11,313 ha of THLB) and have resulted in a large-scale salvage operation. More detail can be found in Table 58 and Figure 53. The base case salvaged merchantable timber within the fires for the first 2 years and assumed a 30% volume reduction in those stands. Over 2042 ha (311,710 m3) were salvaged in the base case, and regenerated as managed stands. The remaining burned, unsalvaged stands were regenerated to natural stands, plus 10% of the total fire area were assumed to become unproductive for the rest of the planning horizon.

There is uncertainty around the future productivity of areas that were not salvage logged. Licensees assume regeneration obligations for salvaged areas but the remaining areas are left to the crown and will likely be left to regenerate naturally. As pine will be the dominant species to regenerate in these fires, there is potential that a portion of these sites will experience repression and become problem forest types in the future if no stand level intervention occurs. This sensitivity explores the implications of 70% of the unsalvaged fire areas dropping out the THLB because they do not regenerate to merchantable stands.

How was it analyzed?

Run	How was it Analyzed?
Regeneration of 2003 Fires	The TSR3 dataset includes 11,313 ha of timber harvesting land base inside the fire boundaries. The base case salvaged 2038 ha in the first two periods, leaving 9275 ha unsalvaged. A portion (70%) of this area is to become unmerchantable (6493 ha) and will no longer contribute to harvest, while 30% (2782 ha) are regenerated as natural stands. This was implemented in the model by assigning all fire areas to a set of analysis units with a high harvest priority. At the end of 3 years, any area not salvaged was transferred to another set of analysis units where a 70% volume reduction was applied (surrogate for a 70% area reduction). These stands remained on these curves for the rest of the planning horizon. The net effect is after 3 years, 6493 ha (1.6% of the THLB) are treated as unproductive.

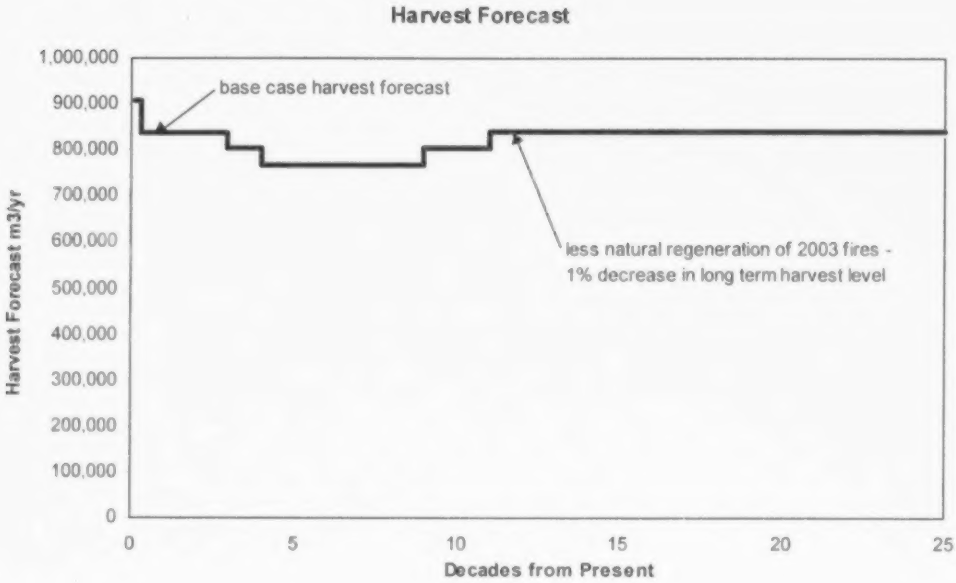


Figure 49. Regeneration in 2003 Fires

Results

Run	Short-term	Mid Term	Long-term
Regeneration of 2003 Fires	No change	No change	The long-term harvest decreases by 1% to 833,000 m3/yr.

The loss of THLB area (6493 ha or 1.5%) does not impact the short-term harvest flow but does reduce the long-term harvest level by 1%. The short-term is not affected because there is no loss of mature volume when these stands are removed from the THLB. The volume loss is already modelled in the base case and this sensitivity is only concerned with the amount of area that will regenerate to productive stands. Thus the loss of THLB is only recognized when the excluded sites would have produced merchantable timber in the future (long-term harvest flow).

6.14 Summary of Sensitivity Analyses

Table 8. Summary of Sensitivity Analysis Results

Run	Change in Analysis from Base Case	% Change to Harvest Forecast Decade			
		1	2-3	4-8	9-25
Timber harvesting land base increase	10% increase in the timber harvesting land base	0.0%	0.0%	9.3%	10.9%
Timber harvesting land base decrease	10% decrease in the timber harvesting land base	0.0%	-19.0%(by 3rd decade)	-11.0%	-10.2%
Natural Stand yield increase	10% increase in natural stand yields	0.0%	0.0%	0.0%	1.5%
Natural Stand yield decrease	10% decrease in natural stand yields	0.0%	-19.1%	-11.0%	1.4%
Managed stand yield increase	10% increase in managed stand yields	0.0%	0.0%	0.0%	10%
Managed stand yield decrease	10% decrease in managed stand yields	0.0%	0.0%	0.0%	-13%
Open Range and Open Forest no yield	No harvest from these stands.	0.0%	-19.0%	-10.0%	-2.7%
Open Forest Future Entry Yields increase by 50%	50% increase in Open Forest	0.0%	0.0%	0.0%	1.5%
Open Forest Future Entry Yields decrease by 50%	50% decrease in Open Forest	0.0%	0.0%	0.0%	-2.1%
Minimum Harvest Ages increase	Increase by 10 years	0.0%	-8.5%	-9.0%	3.4%
Minimum Harvest Ages decrease	decrease by 10 years	0.0%	0.0%	0.0%	0.0%
Relative Oldest First Harvest Rule	Change harvest rule to relative oldest first	0.0%	0.0%	0.0%	1.4%
Random Harvest Rule	Change harvest rule to random oldest first	0.0%	-8.5%	0.0%	1.1%
SIBEC Adjustments	Use coarse PEM to SIBEC adjust site index	0.0%	0.0%	9.3%	15%
PEM-based Ungulate Winter Range	Replace KBLUP UWR with PEM UWR	0.0%	0.0%	9.3%	3%
New caribou	Replace old caribou mapping with new habitat types	0.0%	0.0%	2.1%	0.8%
2013 Use of Select Seed	Use 2013 levels for gains on future managed stands	0.0%	0.0%	0.0%	1.4%
No Use of Select Seed	Use of no select seed	0.0%	0.0%	-5.9%	-5.2%
Regeneration delays	Change regeneration delays from 1 to 3 years	0.0%	-8.5%	0.0%	-3.3%
OGMA/MMA Modelling	Replace spatial OGAM's and MMA's with aspatial constraint	0.0%	0.0%	0.0%	0.0%
Mountain Pine Beetle	Model severe outbreak and salvage in decade 1 to 2	0.0%	-29%	-25%	-2.3%
2003 Fires	Model additional loss of productivity due to fires	0.0%	0.0%	0.0%	-1.0%

7.0 Socio-economic Assessment

7.1 Introduction

To inform the TSR3 process, this socio-economic assessment (SEA) estimates the likely economic activity associated with alternative timber supply scenarios. A region's timber supply is a fundamental determinant of the size of its forest industry, which is often a leading sector in BC regional economies. The Chief Forester determined allowable annual cut (AAC) effectively sets the upper limit on the annual timber supply available for harvest in a TSA. Changes to an AAC have important economic consequences so gauging their likely impacts provides important decision making information for TSA stakeholders and the Chief Forester.

This socio-economic analysis compares the level of employment, employment income and government revenues that the current AAC can support with the timber harvest levels that are proposed by the base case timber supply forecast. It also includes the following elements.

- Brief socio-economic profile of the TSA
- Brief profile of the TSA's forest industry
- Estimate of employment supported by recent harvesting in the TSA

7.2 Current socio-economic setting

7.2.1 Current population and demographic trends

The Cranbrook TSA lies in southeastern BC, between the BC-Alberta border on its eastern boundary and the Purcell Range on its western boundary. The Canada-US border forms the TSA's southern boundary. The Kootenay River flows southward through the Rocky Mountain Trench in the TSA, which includes the city of Cranbrook, a regional service centre of about 19 000, and four other incorporated municipalities: Kimberley, Fernie, Sparwood, and Elkford. St. Mary's and Tobacco Plains are Ktunaxa First Nations communities with a population total of about 400[4]. Cranbook accounts for about 40% of the TSA's approximate population of 47 000.

The TSA's population growth has lagged the province-wide performance by a wide margin over the past two decades. For the 1981-2001 census period, the TSA's population dropped by 0.3% whereas BC's population increased by more than 40%. Cranbrook, with its College of the Rockies, airport, government offices, shopping malls and other regional services, has registered positive population growth over the past 20 years, 17.9%, but this increase is less than half of the province-wide percentage increase. Declines in communities other than Cranbrook led to an overall TSA population reduction for the 1981-2001 and the 1996-2001 periods. In the TSR2 socio-economic analysis, the TSA was projected to increase its population between 1996 and 2001 by 3.5%, instead it recorded a 1.3% decrease, due to contractions in resource sector and government employment. Table 9 presents population data for the TSA, Cranbrook and the province.

Table 9. Population 1981 - 2001

Areas	**2001 Population**	**% change '01 over '96**	**% change '01 over '91**	**% change '01 over '81**
Cranbrook TSA	46 979	- 1.3	3.0	- 0.3
Cranbrook	19 280[5]	2.4	17.2	17.9
BC	3 096 891	4.9	19.1	42.4

Source: BC Stats

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[4] Statistics Canada lists Tobacco Plains reserve as having a population of 82 at the time of the 2001 Census

[5] Cranbrook's 2003 population was estimated as 19 327, a 0.1% increase from its' 2001 level [BC Stats February 26, 2004]

7.2.2 Economic profile

Results from the 2001 Census indicate that employment supported by the public sector comprises the largest portion (29% in 2000) of the TSA's basic sector employment[6]. The forest industry's share dropped in the latter half of the 90s from about 17% in 1995 to 13% in 2000. Table 10 gives the percentage share by basic sector of employment in 2000 and 1995 and the percentage share of employment income by basic sector for 2000.

Table 10. Basic Sector Employment and Employment Income Distribution (% share)

	Forest	**Mining**	**Fish/ Trap**	**Agri cultu re**	**Tour-ism**	**High Tech**	**Public sector**	**Const-ruction**	**Other basic**	**Trans-fers**	**ONEI**[7]	**Total**[8]
2000 Employment income	13.0	21.1	0	1.1	7.8	0.1	21.7	5.4	2.8	14.6	12.6	100
2000 Employment	13.4	19.4	0	3.2	21.6	0.4	28.6	8.2	5.1	0	0	100
1995 Employment	16.7	21.4	0.1	2.8	15.7	0.3	27.3	9.9	5.7	0	0	100

Source: BC Stats

The BC Government has not prepared a more recent basic sector income analysis, however, a new analysis would indicate a smaller impact from the mining sector as Teck Cominco closed Kimberley's Sullivan Mine in late 2001 after almost 100 years of operation. The tourism sector would have a larger impact as the St Eugene Mission Resort opened in 2001, featuring a 125 room hotel and an 18 hole championship golf course (managed by Delta Hotels) and Casino of the Rockies (operated by Gateway Casinos and BC Lotteries Corporation).

The TSA's forest sector vulnerability index of 12 (as calculated by BC Stats) is relatively low[9], indicating that its' forest industry, although important, is but one of a few drivers of the regional economy. Its' diversity index (as calculated by BC Stats) is 74, the highest of any TSA in the province, indicating an economy that is not tied to one or two sectors for its' wellbeing[10].

The economic importance of the resource extraction industries is more noticeable when the focus is on employment income. The forest and mining industries account for 13% and 21%, respectively of basic sector employment income. In comparison, the TSA's tourism industry's employment income is estimated at an 8% share, despite tourism having a 22% share of TSA basic sector employment. The relatively lower salaries and wages in the tourism and public sectors are the reasons for the drop in their economic importance when employment income is the focus.

Jobs with higher incomes can support more spending in local service and retail outlets. The next table presents employment incomes by major BC industries and shows that the forest and coal mining industries have the highest average incomes in the province. The BC logging industry average of $44 642 is 40.0% more than the all industries average of $31 899.

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[6] "Basic sector" is the economics term for the collection of industries that draw revenue from outside the plan area. Non-basic sector is the term for the collection of businesses and organizations that rely on local spending, mainly retail and service businesses. Basic industry revenue may arise from the selling of goods (e.g. lumber) or services (e.g. fishing lodge accommodation and guiding). Some industries have basic and non-basic characteristics and judgement is required in allocating between the sectors. The transportation industry is an example, with local long-haul truckers serving local businesses on an outgoing basis and serving outside parties with backhauls. Government services, from a TSA perspective, comprise a basic industry since public services do not directly depend on TSA tax payments and other government charges. The relative employment share shown in Table 10 for each basic sector industry includes the total of its direct and indirect components.

[7] Other Non-Employment Income (ONEI), mainly investment and pension income

[8] Totals do not add up to 100% due to rounding.

[9] This index is a relative one. Port Hardy is the most forest industry dependent community in the province and therefore carries a vulnerability index rating of 100. Victoria is the least vulnerable from a forest industry perspective and so carries an index rating of 0. TSAs and communities are ranked vis a vis the forest sector dependence of these two communities. To indicate the Cranbrook TSA's standing, Kamloops TSA has a forest vulnerability index of 12. The Quesnel TSA's forest vulnerability index is much higher at 81.

[10] This index is based on relative dependence on a single sector. If an area was entirely dependent on one sector, its' diversity index would be 0. It would be 100, if the area was equally dependent on each defined sector. The BC diversity index numbers tend to range between 50 and 75, so the Cranbrook TSA can be characterized as highly diversified within the BC context.

Table 11. Average BC incomes and Cranbrook TSA employment multipliers

Industry	Income[11]	Indirect Multiplier	Indirect/ Induced[12] Multiplier
Logging	$44 642	1.18	1.28
Saw milling	$42 555	1.33	1.50
Pulp manufacturing	$58 995	1.71	2.00
Coal mining	$55 176	1.31	1.51
Government services	$42 258	1.13	1.22
Accommodation services	$20 461	1.09[13]	1.13
All industries average	$31 899	-	-

Source: Statistics Canada and BC Stats

The indirect and induced spending of the resource extraction sectors in the Cranbrook TSA is also much higher than for other sectors, such as government and tourism. Table 11 lists the indirect and combined indirect and induced multipliers for the Cranbrook TSA. The TSA's logging industry creates double the indirect and induced employment of its' tourism sector and local saw milling creates almost three times the indirect and induced employment as the TSA's tourism sector.

In 1996, the unemployment rate in the Kootenay Development Region was the same as the BC average, 8.7%. Over the intervening years, the Kootenay unemployment rate has increased substantially due to labour productivity improvements and economic upheavals in the region's large resource extraction industries, reaching 13.3% in February 2004. The BC unemployment rate has fluctuated within a narrow range over the same period. The following table compares the Kootenay Development Region and BC unemployment rates.

Table 12. Unemployment rates (%)

Region	1996	1997	1998	1999	2000	2001	2002	2003	2004
Kootenay	8.7	9.3	11.8	9.0	10.1	9.6	10.1	11.5	13.3
BC	8.7	8.4	8.8	8.3	7.2	7.7	8.5	8.1	7.6

Source: BC Stats

7.3 Cranbrook TSA forest industry

7.3.1 Current Allowable Annual Cut (AAC)

The Chief Forester set the current AAC of 941 000 m^3 effective January 2004, which is 70 000 m^3 (8.0%) higher than the previous AAC of 871 000 m^3 (that became effective January 2001). The January 2004 AAC is the result of a temporary, three-year uplift to salvage wildfire timber in the Lamb, Ram, Cummings, and Plumbob Creek areas. Both the January 2004 and January 2001 AACs include 33 000 m^3 from Fire-Maintained Ecosystem and Problem Forest Types Partitions, which do not form part of the TSA's long-term land base. The long-term harvest level based on the Conventional Partition is 838 000 m^3, which is 12 000 m^3 (1.4%) lower than the TSR1 AAC of 850 000 m^3 set in January 1996.

Replaceable forest licenses account for 78.5% of the AAC apportionment. Tembec Industries Inc. (Tembec) has the TSA's largest commitment, 607 652 m^3 attached to its replaceable forest license, accounting for 64.6% of the AAC. Galloway Lumber Company Ltd. (Galloway) has rights to 131 100 m^3 (13.9%) of the current AAC. Table 13 presents the current apportionment and commitments for the Cranbrook TSA.

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[11] Sourced from 2001 Census, reported in 2000 constant dollars

[12] Assumes no migration in the event of lay-off

[13] The indirect and indirect/induced multipliers refer to the overall tourism sector, which includes the accommodation industry

Table 13. Cranbrook TSA AAC Apportionment and Commitments (m^3 & % of AAC)

Licensee by Form of Agreement	**m^3**	**% of AAC**
Forest Licenses Replaceable	738 752	78.5
Tembec Industries Inc.	*607 652*	*64.6*
Galloway Lumber Company Ltd.	*131 100*	*13.9*
Forest Licenses Non-Replaceable[14]	100 000	10.6
Ktunaxa/Kinbasket Development Corp.	*16 667*	*1.8*
Ktunaxa/Kinbasket Development Corp.	*68 333*	*7.3*
TSL<=10 000 m3, replaceable	5 672	0.6
Donald Mallard	*76*	*0.0*
McDonald Ranch and Lumber Ltd.	*5 596*	*0.6*
BCTS Timber Sale License/License to Cut	88 458	9.4
Forest Service Reserve[15]	8 118	0.9
Total Allowable Annual Cut[16]	941 000	100.0

Source: Ministry of Forests, Revenue Tenures and Engineering Branch - unallocated

BCTS has almost 10% of the current AAC. This share is expected to increase to about 20% when the "takeback" process[17] under the BC Government's Forestry Revitalization Plan is completed by the end of 2004. Discussions are underway between Tembec and the BC Government about the amount of timber that the company will yield for the "takeback" process, possibly some volume may come from its Cranbrook license[18]. Approximately 190 000 m^3 has been taken back from Tembec under this process but the location by TSA where this timber will emanate from has yet to be finalized.

In December 2003, the BC Government awarded two non-replaceable forest licenses having a total volume of up to 255 000 m^3 to the Ktunaxa Kinbasket Development Corporation (KKDC)[19]. This timber was mainly drawn from the fire damaged timber partition of the TSA's AAC. In mid-March 2004, Tembec and KKDC announced an agreement whereby Tembec would manage up to 205 000 m^3 and would pay KKDC a $2/ m^3 commission for harvested timber and award contracts to sanctioned First Nations companies and individuals if they are price competitive and qualified to undertake the desired work.

The BC Government, along with Tembec, is discussing an area-based pilot Community Forest License with the Ktunaxa Kinbasket Development Corporation for the so-called Dominion Coal Blocks, federal government owned land that the BC Government manages. This land could support an estimated annual long-term timber harvest of approximately 8 000 m^3. It does not form part of the TSA's timber harvesting land base.

The BC Government has presented a forestry and revenue sharing agreement proposal to the Ktunaxa Kinbasket Tribal Council[20] but neither the KKTC nor its member First Nations have accepted the proposal at the time of this report's preparation[21].

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[14] The 100 000 m^3 total volume for Non-Replaceable Forest Licences (NRFLs) is partitioned into 70 000 m^3 of Fire Damaged Timber and 30 000 m^3 of Problem Forest Types Timber; there is no Conventional Timber in the NRFL partition.

[15] The 8 118 m3 total volume for Forest Service Reserve is partitioned into 5 118 m^3 of Conventional Timber and 3 000 m^3 of Fire-Maintained Ecosystem Restoration Timber.

[16] There are three non-conventional partitions comprising 11.0% of the TSA's AAC. The remainder is conventional timber.

[17] The "takeback" is a reallocation of 20 per cent of logging rights from major licensees. Source: BC Ministry of Forests Backgrounder dated March 26, 2003, available at http://www.for.gov.bc.ca/mof/plan/timberreallocation.htm

[18] Galloway Lumber does not have to give up a portion of its licence volume because only companies holding timber harvesting rights to 200 000 m^3 or more must participate in this initiative.

[19] Acting as the agent of the Ktunaxa Kinbasket Tribal Council

[20] If a Ktunaxa Kinbasket forestry and revenue sharing agreement has the same structure as recently signed ones, then there will be a non-replaceable forest licence, annual revenue stream, and opportunity to apply for a forest licence.

[21] The member First Nations of the KKTC have been developing their forest sector infrastructure in the past few years. For example, each has a resources coordinator, the Ktunaxa Kinbasket Development Corporation is working with Tembec and Canfor on managing the harvesting of the temporary AAC uplift for salvaging wildfire timber, and the human resources division of the KKTC joined with several partners to deliver a college level integrated resource management program for several First Nation members.

7.3.2 Cranbrook TSA harvest history

The Cranbrook TSA's actual harvest has been consistently above its AAC in recent years. The gap between harvest and AAC is primarily due to differences in calculation methods used when determining volumes for billing purposes versus volumes for cut contrrol purposes and over-cut of the FS Reserve. There is strong market demand for the TSA's timber, which arises from the area's relatively lower harvesting cost, continuing strong end use market demand in the US and large wood processing capacity in the TSA. The TSA's harvest to AAC ratio is an average of 114% for the 1998-2002 period. Table 14 summarizes the TSA's timber billed harvest volume over the 5-year 1998-2002 period.

Table 14. Cranbrook TSA Volume (m^3) Billed by Form of Agreement (1998-2002)[22]

Form of Agreement	**1998**	**1999**	**2000**	**2001**	**2002**	**3 yr. avg.**	**5 yr. avg.**
Forest license	658 550	716 315	937 956	798 948	796 466	844 457	781 647
BCTS/SBFEP	47 567	126 728	137 082	100 125	111 393	116 200	104 579
TSL	1 053	6 032	3 189	15 500	16 832	21 174	8 521
Other[23]	65 358	92 937	117 840	86 769	35 467	80 025	79 674
Total	772 528	942 012	1 196 067	1 001 342	960 158	1 052 522	974 421
AAC	850 000	850 000	850 000	871 000	871 000	864 000	858 400
AAC variance Over / (under)[24]	(77 472)	92 012	346 067	130 342	89 158	188 022	116 021
% variance from AAC Over / (under)	(9.1)	10.8	40.7	15.0	10.2	21.8	13.5

Source: BC Ministry of Forests, Revenue Branch

The private lands harvest in the TSA is not included in this analysis but is substantial, an annual average of approximately 250 000 m^3 in recent years, which is about 30% of the AAC. Tembec has a private Managed Forest (#27) within the TSA boundaries. The woodlot license harvest is also substantial in recent years, an average of approximately 30 000 m^3.

7.3.3 Cranbrook TSA major licensees and processing facilities

Overview

Tembec Industries Inc. is the TSA's main forest industry actor; the company has rights to approximately two-thirds of the TSA's AAC and owns about 70% of the TSA's timber processing capacity.

There is a rough balance between recent annual TSA harvests and timber processing capacity located within TSA boundaries; the average 2001-2003 TSA billed volume was about 1 million m^3 and timber consumption by the TSA's three largest timber processing facilities averaged about 1.1 million m^3 over the same period. When timber harvests from private lands and woodlot licenses are considered there is a surplus of fiber within the TSA that is transported to other areas, especially Invermere TSA mills. Annual regional timber processing capacity[25] totals about 2.9 million m^3 and the regional AAC totals[26] approximately 2.3 million m^3, leaving a gap of 0.6 million m^3, which is mainly filled by private land harvests. Table 15 lists the TSA's wood processing facilities and their locations, main products and estimated annual output capacities.

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[22] Accurate data for 2003 TSA harvest volume for the complete year was not available at the time of this report's preparation in early 2004.

[23] Other includes licence to cut, right-of-way clearings, roads, trespasses and other miscellaneous harvests

[24] BC Government cut control policies have allowed licensees to harvest + or – 50% per year from their licenced volume and + or – 10% over a five-year cut control period. These provisions are intended to provide licensees with sufficient flexibility to adapt to changing market and climatic conditions. The minimum harvest requirement was eliminated as of November 2003.

[25] Invermere TSA – 1.25 million m3; Cranbrook TSA – 1.1 million m3; and Kootenay Lake TSA – 0.52 million m3.

[26] Invermere TSA – 581 570 m3; Cranbrook TSA – 871 000 m3; Kootenay Lake TSA – 700 000 m3; and TFL 14 – 160 000 m3.

Table 15. Cranbrook TSA timber processing facilities

Timber Processing Facility	Location	Main Product	Est'd annual output capacity[27]
Tembec Industries Inc.	Elko	Lumber (dimension)	172 million bd ft
Galloway Lumber Co. Ltd.	Galloway	Lumber (dimension)	65 million bd ft
J.R. Blackmore & Sons Ltd.	Lumberton, Caven, Kitchener	Posts, rails & stakes	3 million pieces
Bear Lumber Ltd.	Cranbrook	Lumber (timbers)	4.5 million bd ft
McDonald Ranch and Lumber Ltd.	Grasmere	Lumber (timbers)	4 million bd ft
Selkirk Forest Products Ltd.	Galloway	Poles	24 000 pieces
Canalog Wood Industries Ltd.	Cranbrook	log homes	NA

Source: Survey of TSA timber processing facilities and BC Ministry of Forests, Economics and Trade Branch (June 2003) *Major Primary Timber Processing Facilities in British Columbia 2002.*

Tembec Industries Inc.

Temiscaming, Quebec headquartered Tembec is the main forest industry employer in the TSA, having harvesting operations and a dimension lumber mill at Elko. The company also has a planer mill and Value Added Centre at Cranbrook. The average annual processing employment supported by wood fiber from all sources at these facilities over the 2001-2003 period was as follows: Elko saw mill - 218 PYs; Cranbrook planer mill - 76 PYs; Cranbrook Value Added Centre - 46 PYs; total - 340 PYs.

Including harvesting, planning, administration, log hauling, road building, silviculture, sawmilling, planing and pulpmaking operations, Tembec generated an annual average of 535 PYs of forest industry employment involved with harvesting and processing its Cranbrook TSA Forest License timber over the 2001-2003 period[28].

These TSA operations formerly belonged to Crestbrook Forest Industries Ltd. (Crestbrook), which amalgamated with Tembec in 1999.

Tembec's Elko mill makes mainly 2x4 studs for the American housing market. This mill consumed approximately 875 000 m^3 of timber per year over the 2001-03 period, running three shifts. The volume attached to the company's replaceable forest license is 607 652 m^3. The company sends a small portion of its Cranbrook TSA Forest License harvest to its' Canal Flats saw mill. The gap, between the Cranbrook TSA Forest License harvest and Elko mill timber consumption, is mainly filled by sourcing timber from BCTS sales, and the company's Managed Forest (#27)[29] and Kootenay Lake TSA Forest License. The Elko mill ships trim blocks to Tembec's Cranbrook Value Added Centre and residual chips to the company's Skookumchuk pulp mill, located on the boundary of the Cranbrook and Invermere TSAs.

Crestbrook had another large saw mill in the TSA, located in Cranbrook, but closed it in October 1998 and increased sawmilling utilization at its' nearby Elko and Canal Flats mills. Tembec re-opened the facility in September 2000 as a planer mill and the Cranbrook Value Added Centre to manufacture long length economy lumbers. It was closed in November 2001 as a result of US imposed penalties on softwood lumber. Tembec retooled the facility to manually process planer trim blocks into finger jointed products[30], such as 2x3, 2x4 and 2x6 and re-opened it in November 2002. The center has 24 million board feet capacity and its' products are sold into the US housing market. The Cranbrook planer mill supplements the company's planer operations at

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[27] Based on 480 8-hour shifts per year

[28] This figure is based on employment involved with processing timber. Tembec's Value Added Centre in Cranbrook averaged employment of 46 PYs for 2001 and 2003. It sourced trim blocks from the company's Elko and Canal Flats mills and its Cranbrook planer mill.

[29] Located in the Elk Valley

[30] It is a secondary wood processing facility so does not appear on the list of primary timber processing facilities of Table 15

Elko and Canal Flats (in the Invermere TSA). Other major recent capital improvements include a grading optimizer at the Elko planer and a new debarker for the Elko saw mill.

The following table presents recent harvesting and employment results for Tembec in the Cranbrook TSA.

Table 16. Tembec annual average TSA Forest License harvests and employment, 2001-2003

	Result
Harvest	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	607 652
Annual average harvest, 2001-2003	597 000
2003 harvest	561 000
Employment	**Person-Years (PYs)**
Harvesting, planning & administration	215
Log transport	36
Road construction & maintenance	17
Silviculture	33
Timber processing	234
Total	535

Source: Ministry of Forests, survey of licensees and author's calculations

Galloway Lumber Co. Ltd.

Galloway, BC headquartered Galloway Lumber Co. Ltd. is the second leading forest industry employer in the TSA. Including harvesting, planning, administration, log hauling, road building, silviculture, sawmilling, planing and pulpmaking operations, Galloway generated an annual average of 104 PYs of forest industry employment involved with harvesting and processing its Cranbrook TSA Forest License timber over the 2001-2003 period. It is a family owned company bought by the Nelson family in 1950 and amalgamated with Silver Ridge Sawmills about 12 years ago,

The company has a dimension lumber mill in Galloway, 50 kilometers east of Cranbrook, which consumed an annual average of 175 000 m^3 of timber over the 2001-03 period. Galloway's replaceable forest license volume is 131 300 m^3, leading the company to fill the shortfall through BCTS sales and private lands purchases. All the harvested timber from this license is processed in Galloway's saw mill, which averaged 48 PYs of annual processing employment supported by wood fiber from all sources over the 2001-2003 period. The company ships residual chips to Celgar Pulp Ltd. at Castlegar. All of the workers associated with harvesting and processing timber from this license live in the Cranbrook TSA except for the small amount of Castlegar employment associated with pulpmaking from the Galloway chips.

The following table presents recent harvesting and employment results for Galloway in the Cranbrook TSA.

Table 17. Galloway annual average TSA Forest License harvests and employment, 2001-2003

	Result
Harvest	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	131 300
Annual average harvest, 2001-2003	136 000
2003 harvest	132 000
Employment	**Person-Years (PYs)**
Harvesting, planning & administration	27
Log transport	8
Road construction & maintenance	2
Silviculture	9
Timber processing	58
Total	104

Source: Ministry of Forests, survey of licensees and author's calculations

BC Timber Sales (BCTS)

BCTS has about 10% of the TSA's AAC, 88 458 m^3. This figure may double when the "takeback" process is concluded. The BCTS harvest averaged about 115 000 m^3 over the past three-year 2000-2002 period. The estimated average annual employment supported by the harvest and processing of BCTS timber was 98 PYs[31] for this period. BCTS registrants who reside in the TSA account for an estimated 90% of the BCTS harvest.

The following table presents recent harvesting and employment results for BCTS.

Table 18. BCTS annual average harvests and employment, 2001-2003

	Result
Harvest	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	88 458
Annual average harvest, 2000-2002	116 200
2002 harvest	111 393
Employment	**Person-Years (PYs)**
Harvesting, planning & administration, log transport, and road construction & maintenance	45
Silviculture	7
Timber processing	46
Total	98

Source: Ministry of Forests, survey of licensees and author's calculations

Other TSA Timber Processors

J.R. Blackmore & Sons Ltd. is the third largest timber processor in the TSA. It has post processing plants at Lumberton, Caven (near Elko) and Sulpher Springs (near Sparwood). The company's timber processing employment averaged 29 PYs over the 2001-2003 period. As well, it has a mechanical shop at Kitchener and a pressure treatment operation at Cranbrook. It annually produced over three million pieces (fence posts, rails and grape stakes) . Its' annual timber consumption has averaged approximately 80 000 m^3 in recent years and the company relies on Cranbrook TSA BCTS sales for a significant portion of its' fiber needs.

Bear Lumber Ltd. is a small head rig saw mill located in Cranbrook for approximately 25 years. It produces about 4.5 million bd ft annually and consumes about 8-10 000 m^3 of timber purchased in private sales each year. Eight persons staff the mill on a full-time basis. It buys lower value beetle killed pine logs and processes them into timbers.

MacDonald Ranch and Lumber Ltd. (MRL) is a small, family owned operation established in 1956. It is located in Grasmere. Its' main product is currently timbers for the residential and commercial building markets. It has a Wood-Mizer band saw mill that focuses on logs of up to 30" diameter. In addition to its replaceable timber sale license, MRL bids on BCTS timber sales. The company trades most of its harvest for logs that fit the profile of its' mill and markets. This small mill's estimated annual timber input capacity is 30 000 m^3 and the volume of its replaceable timber sale license is 5 596 m^3.

Ktunaxa First Nation – There are two small portable mills operated by Ktunaxa First Nation members who reside in the Tobacco Plains community. These mills are operated on an intermittent basis based on customer need.

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[31] To construct this estimate, the BCTS harvest was multiplied by the forest industry employment coefficients (PYs per '000 m^3) derived from averages of licensees and other operators in the TSA and includes employment associated with TSA timber that is processed outside the TSA.

7.3.4 Forest sector employment and employment coefficients

The average annual total direct forest industry employment supported by Cranbrook TSA harvested timber over the 2000-2002 period is 726 PYs in the TSA and 895 PYs province-wide. On a province-wide basis, the TSA's annual harvest supported total[32] employment of approximately 1 900 PYs in recent years.

Table 19 presents estimates of annual employment supported by the 2000-2002 Cranbrook TSA harvest broken down by forest industry activity. Employment is reported as an annual average and as the intensity of employment per '000 m^3 of harvested timber. The latter figure is used to calculate potential employment impacts of alternative timber supply scenarios. The average employment levels and coefficients are reported at TSA and provincial levels[33].

Table 19. Cranbrook TSA timber supported employment and employment coefficients (2000-2002)

Activity	TSA		Province	
	Employment (PYs)	Employment Coefficient (PYs/'000 m^3)	Employment (PYs)	Employment Coefficient (PYs/'000 m^3)
Direct employment				
Harvesting[34]	400	0.38	410	0.39
Silviculture[35]	42	0.04	63	0.06
Timber processing[36]	285	0.27	421	0.40
Total direct employment	726	0.69	895	0.85
Indirect/induced employment	271	0.26	1 022	0.97
Total employment	997	0.95	1 917	1.82

Source: survey of licensee's and author's calculations

Almost 100% of persons engaged in harvesting reside in the TSA. The majority of the harvesting occurs from May through March, stopping in the spring because of poor ground conditions. Ground-based skidder harvesting systems are the most common, accounting for about 80% of the harvesting, but there is more cable and helicopter logging in recent years.

Cranbrook TSA licensees are responsible for basic silviculture (i.e. establishment of a free-growing stand) on areas harvested under major licenses. BC Ministry of Forests is responsible for silviculture on areas harvested by BCTS award holders and on backlog not satisfactorily restocked (NSR) areas. The silviculture direct employment coefficient is listed as 0.06 PYs per '000 m^3 of harvested timber. This figure is an approximation of annual activity as silviculture work in any one year is not directly tied to the harvest of that year. If an area is harvested in the early summer, then planning and site preparation work will often occur in the fall and planting in the following spring.

The per cubic metre employment attached to the Cranbrook TSA harvest has declined over the past decade as a result of declining employment in processing. Processing employment intensity is lower since the early 90s because of labour productivity improvements in the major sawmills, closure of Crestbrook's smaller and less efficient Cranbrook saw mill in 1998 and closure of a few smaller, more labour intensive processing facilities. In the early 90s, processing employment attached to TSA timber was 0.71 PYs/'000 m^3. In the 2000-02 period, it is about 40% lower, 0.40 PYs/'000 m^3.

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[32] Total employment is comprised of direct, indirect and induced employment. Direct employment estimates come from a survey of licensees. Indirect and induced employment estimates are calculated with the aid of multipliers developed by BC Stats, which uses its input/output model and 2001 census results to estimate local and provincial multipliers. For more explanation about the estimates see Appendix G, *Socio-Economic Analysis Background Information*.

[33] TSA level is defined as residents of the Cranbrook TSA who are employed in the forest industry and its indirect and induced sectors. Provincial level is defined as all forest sector employment in BC that relies on the Cranbrook TSA harvest, including both residents of the TSA and those who live elsewhere in the province.

[34] Includes harvesting, log transportation, log salvage, log scaling and harvest planning and administration

[35] Includes site preparation, planting, spacing, fertilization, pruning and silviculture planning

[36] Includes management, administration as well as facility operations

The forest sector employment estimates do not include BC Ministry of Forests (MOF) employment in the TSA[37]. Cranbrook TSA, along with Invermere TSA, is part of the Rocky Mountain Forest District, and its' District Office is located in Cranbrook and had 38 FTEs as of December 2003. There is a field office in Invermere with 7 FTEs. BCTS' Cranbrook office had 7 FTEs as of December 2003[38].

7.3.5 Forest sector employment income

On a province-wide basis, the Cranbrook TSA harvest supported an estimated average annual total employment income of $74 million ($69 900 per harvested m^3) for the 2000-2002 period; $41 million ($38 900 per harvested m^3) of direct forest industry employment income and $33 million ($31 000 per harvested m^3) of indirect and induced employment income. The employment income contribution of the forest industry is high in part because of the industry's relatively higher income levels (listed in Section 7.2.2). Table 20 suggests that there is about $40 000 of BC forest industry employment income for every 1 000 m^3 harvested in the TSA.

Table 20. Cranbrook TSA timber supported employment income estimates and employment income coefficients (2000-2002)

Activity	**Employment (PYs)**	**Annual income per worker ($)**	**Total employment income[39] ($million)**	**Employment income coefficient ($/'000 m^3)**
Direct employment				
Harvesting & forestry services	473	44 642	21.14	20 085
Solid wood processing	305	42 555	12.99	12 342
Pulp & paper processing	116	58 995	6.83	6 489
Sub-total direct employment	895		40.96	38 917
Indirect/induced employment	1 022	31 899	32.59	30 964
Total employment	1 917		73.55	69 881

Source: survey of licensee's and author's calculations

7.3.6 Provincial government revenues

Altogether, the BC Government is estimated to have annually collected about $35 million ($33 000 per harvested m^3) of revenues on average over the 2000-2002 period from the TSA's harvest. There are three main sources of BC Government revenues from the forest sector as follows.

- Stumpage – which is a type of royalty paid for the right to harvest and use Crown-owned timber. The stumpage calculation method is in transition at this juncture from the Comparative Value Pricing System (CVP)[40] to a Market Pricing System (MPS). The new MPS went into effect for BC coastal timber on February 29, 2004 and is scheduled to go into effect for BC Interior timber by the end of 2004. An estimate of 2004 MPS stumpage in Cranbrook TSA is not available at this juncture. The average 2001-2003 Cranbrook TSA stumpage was $14.16/ m^3 and the average 2003 stumpage was $12.25/ m^3.
- *Other forest industry taxes* – This category includes logging taxes, corporate income taxes, property taxes, export fee in lieu of manufacture against exported logs, gas tax, sales taxes and Workers Compensation Board premiums paid by forest industry employers. The estimate of other forest industry taxes[41] is a unit cost total[42] of $11.42 per harvested m^3. It should be

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[37] Ministry of Forests employment is not included as part of direct forest industry employment because it is related to administration and statutory requirements and not to timber harvest levels and would not be affected by marginal timber supply changes. MOF employees are accounted for in the public service sector employment estimates reported in Section 7.2.2.

[38] In 1999, the Cranbrook Forest District Office was listed as having approximately 60 employees [BC Ministry of Forests 1999].

[39] Province-wide basis

[40] Adopted in 1987

[41] Unit costs for each tax item were obtained from PriceWaterhouseCoopers (2000) *The Forest Industry in British Columbia 1999*.

interpreted as a very gross estimate because it includes several tax items that often change on a year-to-year basis.

- Provincial income taxes and sales taxes – Forest industry employees and employees in the industry's indirect and induced sectors pay sales taxes on their personal purchases and provincial income taxes.

Table 21 shows estimates of recent average annual BC Government revenues derived from the Cranbrook TSA timber harvest.

Table 21. Average annual BC Government revenues derived from the Cranbrook TSA timber harvest, 2000-2002

BC Government revenue source	Est'd avg. annual revenues ($million)	BC Govt. revenue coefficient($/'000 m^3)
Stumpage	14.90	14 160
Other forest industry taxes	12.02	11 420
Employment income & employee sales taxes	7.84	7 445
Total revenues	34.76	33 025

7.4 Socio-economic implications of the base case harvest forecast

7.4.1 Introduction

The socio-economic analysis focuses on harvest level changes in the short- to medium-terms (0 – 30 years). Economic impacts are gauged by comparing economic activity that could be supported by the current AAC with activity that could be supported by the base case harvest forecast. Although actual harvest levels drive economic impacts, they closely follow the AAC level in the Cranbrook TSA and so estimates based on AAC timber volume are valid expressions of future forest industry activity in this TSA.

The current AAC is 941 000 m^3, effective January 8, 2004. This AAC reflects a temporary uplift of 70 000 m^3 per year to support the salvage of about 210 000 m^3 of timber damaged by catastrophic wildfires in 2003. The previous AAC of 871 000 m^3 per year was set in January 2001. Both the January 2004 and January 2001 AACs include 33 000 m^3 from Fire-Maintained Ecosystem and Problem Forest Types Partitions, which do not form part of the TSA's long-term land base. The long-term harvest level based on the Conventional Partition is 838 000 m^3.

The base case timber supply forecast is 908 000 m^3 for the initial three years, 33 000 m^3 lower than the current AAC of 941 000 m^3 because of the removal of the Fire-Maintained Ecosystem and Problem Forest Types Partitions from the base case analysis. The 33 000 m^3 of partitiion AAC is still available outside of the timber harvesting land base, but was not analyzed as a part of the base case. The partition will be re-evaluated at the time of the next AAC determination meeting. The base case forecast includes the three-year 70 000 m^3 temporary uplift from the Fire Damaged Timber Partition. After three years the base case harvest forecast falls to 838 000 m^3, remaining there for three decades.

This base case harvest forecast for the next three decades is the same as the Conventional Partition harvest levels of the January 2001 and January 2004 AACs.

From decades 4 through 9, the projected base case harvest drops by 8.5% to 767 000 m^3. In the base case forecast, the projected long term harvest level of 841 000 m^3 is reached in the 11th decade, which is 3 000 m^3 larger than the current conventional January 2001 AAC.

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[42] Removing Workers Compensation Board premiums reduces the unit tax cost to $6.95 per m^3.

7.4.2 Short- and long-term implications of alternative harvest levels

There are no differences in economic activity between the base case forecast and current AAC (based on the Conventional Partition).

The base case harvest forecast of 838 000 m^3 (which extends for three decades) could annually support the following.

- estimated 796 PYs of total employment and $32.4 million of employment income in the Cranbrook TSA
- estimated 1 525 PYs of total employment and $58.5 million of employment income in the province
- estimated $11.9 million of stumpage and $27.7 million of total BC Government revenues

7.4.3 Requirements of BC timber processing facilities

No reduction in the AAC over the next three decades is anticipated and is positive news for timber processing facilities that rely on Cranbrook TSA wood fiber. The stability may be a positive contributing factor in decisions about making capital investments in current timber processing facilities.

7.4.4 Regional timber supply implications

About 15% of the Cranbrook TSA log harvest is directed to the Invermere TSA. Cranbrook TSA timber processors rely on Kootenay Lake and Invermere TSA and private land sources for about 25% of their timber consumption needs. Stability in the Cranbrook TSA will contribute to regional timber supply stability. However, there is a significant reliance by timber processors within the Cranbrook, Invermere and Kootenay Lake TSAs on sourcing private land, Alberta, other TSA timber to meet their wood fiber consumption requirements.

7.4.5 Summary Comparison Table

Estimated employment, employment income and BC Government revenue impacts based on harvesting the base case harvest forecast (and January 2001 and January 2004 Conventional Partition AACs) appears in Table 22.

Table 22. Estimated socio-economic impacts of implementing the base case harvest forecast

	Base case harvest forecast[43]
Harvesting activity	(m^3)
Timber supply	838 000
Cranbrook TSA	
Employment	PYs
Direct	578
Indirect/induced	218
Total	**796**
Employment income	$ millions
Direct	25.5
Indirect/induced	6.9
Total	**32.4**
Province[44]	
Employment	PYs
Direct	712
Indirect/induced	813
Total	**1 525**
Employment income	$ millions
Direct	32.6
Indirect/induced	25.9
Total	**58.5**
BC Government revenues	$ millions
Stumpage	11.9
Other forest industry taxes	9.6
Employee income and sales taxes	6.2
Total	**27.7**

7.5 Summary

Cranbrook TSA enjoys a highly diversified economy in the BC context and the recent expansion of its tourism sector, through the opening of the St. Eugene Mission Resort, expansion of the Fernie ski resort and moulding of the East Kootenay into a destination golf region, only serves to reinforce this desirable feature. The forest and mining industries are the two major resource extraction sectors in the Cranbrook TSA. Tembec Industries and Galloway Lumber are the two major Forest License holders and account for 78.5% of the apportioned AAC of 941 000 m^3, effective January 2004. The TSA's three major timber processors annually consume about 1.1 million m^3 in their TSA operations. Tembec operates a saw mill at Elko and a planer mill and finger jointing plant in Cranbrook. Galloway Lumber has a saw mill at Galloway and J.R. Blackmore & Sons Ltd. has several post and rail making operations in the TSA and relies on Cranbrook TSA BCTS sales for a significant portion of its timber input needs.

The base case timber supply forecast is 908 000 m^3 for the initial three years. The base case forecast includes the 70 000 m^3 temporary uplift from the Fire Damaged Timber Partition. After three years the base case harvest forecast falls to 838 000 m^3, remaining there for three decades.

This base case harvest forecast for the next three decades is the same as the Conventional Partition harvest levels of the January 2001 and January 2004 AACs.

The base case harvest forecast of 838 000 m^3 (which extends for three decades) could annually support the following:

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[43] After the temporary AAC uplift is removed

[44] Provincial estimates include Cranbrook TSA estimates

- estimated 796 PYs of total employment and $32.4 million of employment income in the Cranbrook TSA
- estimated 1 525 PYs of total employment and $58.5 million of employment income in the province
- estimated $11.9 million of stumpage and $27.7 million of total BC Government revenues

Since the base case harvest forecast and the Conventional Partition AAC are the same for several decades there will be neither positive nor negative impacts for the regional economy unless the AAC stability contributes to decisions about capital investments in processing capability. Minor changes in the regional forest sector do not have significant consequences for the Cranbrook area's overall economic wellbeing.

8.0 Conclusions and Recommendations

This analysis report presents a harvest flow with a stable short-term timber supply. Given the inputs and assumptions in the base case, the fire uplift AAC can be harvested for 3 years and then the pre-uplift AAC (838,000 m^3/yr) can be maintained for another 27 years. It then declines in two steps totaling 8.5% to 767,000 m3/yr by decade 5, and then increases to the long term harvest level of 841,000 m^3/yr by the 11th decade.

Critical to the harvest flow was the current age class structure of the timber harvesting land base. There is currently very little timber harvesting land base between the ages of 30 and 50. This 'gap' in age classes creates a potential shortage of harvestable timber in 50-60 years from now. An analysis of the availability of timber for each decade also revealed a similar shortage in available timber in decades 6 and 11. These two shortages or 'pinch points' are largely responsible for the mid-term decrease in harvest. A steady long term harvest flow is possible once the age class structure on the THLB has become more evenly distributed.

The forest cover requirements associated with non-timber objectives also play a role in shaping the base case harvest flow. Cover requirements interact with age class structure to limit the availability of timber over the planning horizon. Without requirements to limit disturbance and/or maintain older stands on the land base, more timber would be available for harvest in the pinch points. Requirements for ungulate winter range (KBLUP UWR guidelines), old seral objectives, caribou habitat and scenic quality are the main resource management objectives that limit timber harvesting in the TSA. Similarly, the objectives for mature seral, watersheds and cut-block green-up appear to be the least constraining on timber supply.

In order to assess the impacts of potential changes to modeling assumptions, and gain further understanding of the dynamics at work in the base case forecast, a series of sensitivity analyses were completed.

The short-term harvest forecast for the base case harvest is affected by changes in many input assumptions. Some of the factors and uncertainties that have a significant downward pressure on the harvest in the short-term include:

- Decreasing the timber harvesting land base 10% results in a decrease in the harvest of 19% by the 3rd decade.
- Decreasing the yields from existing natural stands by 10% decreases the harvest by 19% by the 3rd decade.
- Eliminating harvest yields from open forest and open range stands also decreases the harvest by 19% by the 3rd decade.
- Increasing minimum harvest ages by 10 years will decrease the base case harvest by 8.5% after just one decade.
- Increasing the time it takes to regenerate forest stands after harvest by 2 years will reduce the short-term harvest by 8.5% after just one decade.

Of all the uncertainties examined for the TSA, none had the effect of an immediate reduction in the AAC. Most of the significant uncertainties caused a decrease in harvest to occur after the first or third decade.

These same uncertainties were also examined for their potential upward pressure on timber harvesting. None of the sensitivities performed had the effect of an immediate increase in AAC, but several did have the effect of potentially extending the length of time the current AAC of 838,000 cubic meters per year could be maintained.

The following sensitivities allowed the current AAC to be maintained through the mid-term, with no decrease below the current AAC. These included:

- Increasing the timber harvesting land base 10%.
- Increasing the yields from existing natural stands by 10%.
- Implementation of the Ecosystem based Ungulate Winter Range Guidelines throughout the entire TSA.
- Improved estimates of site productivity through ecosystem based site index adjustments.

The long-term term harvest level is the point at which the timber harvesting land base has developed a more uniform age class structure and the harvest level is non-declining. For the Cranbrook TSA, this occurs around the 11th decade and corresponds with the harvest beginning to come primarily from managed stands.

The sensitivities that show a significant (>3%) decrease in the long-term harvest level included:

- Decreasing the timber harvesting land base 10% decreases the long-term by 10.2%.
- Decreasing the yield estimates from managed stands by 10% decreases the long-term by 13%.
- Assuming that there are no volume gains from the use of select seed decreases the long-term harvest by 5.2%.
- Changing the length of time to regenerate harvested stands from 1 year to 3 years decreases the long-term by 3.3%.

Factors that are can significantly (>3%) increase the long-term harvest level include:

- Increasing the timber harvesting land base 10% increases the long-term by 10.9%.
- Increasing the yield estimates from managed stands by 10% increases the long-term by 13%.
- Increasing minimum harvest ages by 10 years increases the long-term by 3.4%.
- Increases in the estimates of site productivity by applying ecosystem based site index adjustments increases the long-term by 15%.

Although these sensitivities indicate that there is potential for the harvest forecast to change, the base case scenario is felt to best represent the current situation in the Cranbrook TSA. Looking forward, it is highly probable that a number of sensitivities will soon represent 'current management' and change timber supply in the mid- and long-term. These include new ungulate winter range guidelines, new caribou guidelines, better site productivity estimates, and improved gains on select seed. It should be noted that none of the sensitivities examined for the TSA required an immediate reduction in the harvest level.

The following factors were not captured or adequately addressed in the base case analysis and warrant discussion.

1. The provincial Identified Wildlife Management Strategy is may reduce harvest levels by up to 1% in the future. Since the establishment of WHA's has been very slow to date, with few being established in the TSA, a 1% reduction has not been included in this base case.
2. The in-block retention study results used in this analysis addressed the yield implications of stand level retention (single trees, clumps, or patches) by evaluating the loss of volume at time of harvest and loss of site occupancy into the future. However, neither the study, nor the base case model addressed the potential for reduced regeneration performance in the harvested openings around retained stems (shading).
3. The in-block retention study provided a volume reduction percentage to be applied to all clearcut analysis units. This reduction addressed both WTPs and other forms of in-block retention. This lead to double counting because existing WTP's were netted out of the land base. If the WTP's were not netted out of the THLB, it would be 2254 ha (0.5%) larger.
4. The latest inventory audit showed inventory volumes were overestimated by 4.2%. This was not included in the analysis because the 4.2% was not considered statistically significant.
5. The volume of wood salvaged from the 2003 fires in the model was only about 80% of what licensees estimate they will salvage. This is likely due to the difference between minimum harvest ages in the model and what is harvested in the field. The base case is not realizing 83,090 m3 (394,800 est – 311,710 actual) of salvage in the first several years of the forecast and it is lost when these stands regenerate at the end of year 3.
6. Aging of the Open Range and Open Forest polygons were modelled younger than those found in the field. In the model following harvest, the stand age is reset to zero, whereas in the field these stands would continue to age. As a result of this modelling, less area of Open Range and Open Forest were available to contribute to seral goals and more area contributed to ECA's than would be expected.

7. Following the publishing of the Data Package, Rocky Mountain Forest District staff re-evaluated the NRL's for the TSA at 66,132 m3/yr – an 11,109 m3/yr reduction not modelled in TSR3. This positive timber supply influence resulted from a 7,320 m3/yr reduction to the Mountain pine beetle NRL (36,331 m3/yr), the elimination of the 4,048 m3/yr non-catastrophic in-block blowdown/snowpress NRL and increasing the Douglas-fir bark beetle NRL to 450 m3/yr.

Improving upon the base information and assumptions used in this analysis, will allow the next timber supply analysis to provide for improved estimates of harvest flow. Some recommendations for future work to be completed before the next analysis are provided below:

- Ensure the elements necessary to complete a site index adjustment project for the TSA are available for the next TSR. At a minimum, this would include an ecosystem mapping product with accuracy statistics acceptable to MoF Forest Analysis Branch. Better estimates of site productivity will increase yield estimates from managed stands in the mid to long-term.
- Complete a VRI Ground Sampling project for the TSA. A previous inventory audit identified that the yields from natural stands may be over-estimated by 4.2% and this should be investigated further. The short-term to mid term harvest is very dependent upon the yields from natural stands.
- Better define the impacts of root rots on stands yields. Operational Adjustment Factors (OAFs) have been used to represent the yield impact of root rots on fir and pine stands, however more knowledge on how root rots effect yields, as well as the extent of the disease, will improve the certainty of this factor.
- The unproductive area of roads, trails and landings in the Cranbrook TSA is estimated to be 47,833 ha, which is over 11.5% of the timber harvesting land base. This is a very high percentage when compared to other management units in the province. Improving or updating the estimate of roads, trails and landings will directly effect the size of the THLB.
- Completing the establishment of wildlife habitat areas in the TSA will increase certainty of the size of land base available for timber harvesting.

Appendix A - Acronyms

AAC	Allowable Annual Cut	MSRM	Ministry of Sustainable Resource Management
Analysis	Timber Supply Analysis	MSY	Maximum Sustained Yield
AU	Analysis Unit	MSYT	Managed Stand Yield Tables
BCTS	BC Timber Sales (Formerly Small Business Forest Enterprise Program)	MWLAP	Ministry of Water, Land and Air Protection
BEC	Biogeoclimatic Ecosystem Classification		
BEO	Biodiversity Emphasis Options	NCC	Non-Commercial Cover
BGB	Biodiversity Guidebook	NDT	Natural Disturbance Type
BL	Balsam Fir	NP	Non Productive
CF	Chief Forester	NRL	Non-Recoverable Losses
CFLB	Crown Forested Land base	NSR	Not Satisfactorily Restocked
CORE	Commission on Resources and Environment	NSYT	Natural Stand Yield Tables
CW	Western Red Cedar	OAF	Operational Adjustment Factor
DBH	Diameter at breast height (1.3m)	OGMA	Old-Growth Management Areas
DEO	Designated Environment Official	PA	Whitebark Pine
DFO	Department of Fisheries and Oceans	PEM	Predictive Ecosystem Mapping
DM	District Manager	PL	Lodgepole Pine
ESA	Environmentally Sensitive Area	PSP	Permanent Sample Plot
FD	Douglas Fir	PSYU	Public Sustained Yield Unit
FES	Forest Ecosystem Specialist	PW	White Pine
FIP/FC1	Old Forest Cover Digital Files	PY	Ponderosa Pine
FMER	Fire Maintained Ecosystem Restoration	RIC	Resources Inventory Commission
FIZ	Forest Inventory Zone	RM	Regional Manager
FPC	Forest Practices Code	RMZ	Riparian Management Zone
FRBC	Forest Renewal British Columbia	ROS	Recreation Opportunity Spectrum
FSSIM	Forest Service Simulation Model	RTEB	Resource Tenures and Engineering Branch
GIS	Geographic Information System	THLB	Timber Harvesting Land base
HLPO	Higher Level Plan Order	TIPSY	Table Interpolation Program for Stand Yields (growth and yield model)
HW	Western Hemlock	TSA	Timber Supply Area
IWAPS	Interior Watershed Assessment Procedure System	TSR	Timber Supply Review
KBLUP-IS	Kootenay Boundary Land Use Plan – Implementation Strategy	UREP	Use, Recreation, and Enjoyment of Public
KBHLPO	Kootenay Boundary Higher Level Plan Order	VDYP	Variable Density Yield Predictor (growth and yield model)
LA	Alpine Larch	VEG Ht	Visually Effective Greenup Hieght
LRMP	Local Resource Management Plan	VQO	Visual Quality Objective
LTHL	Long-term Harvest Level		
LU	Landscape Unit		
LW	Western Larch		
MoF	Ministry of Forests		

Appendix B – Data Inputs and Modeling Assumptions

Changes from the January 29, 2004 Data Package v3.0 (Approved February 6th, 2004)

- WTP's and in-block retention are now addressed using a 2.7% volume reduction on all clearcut yields curves (not open range or open forest). This value was determined in a in-block retention study completed by Forsite in March 2004. The study was based on 1948 ha of cutblocks (42 SP's).

- A base case caribou cover constraint was increased. The ESSF below Caribou line constraint was increased from 30%>140 to 40%>140 to compensate for partial cutting restrictions on an additional 20% of this zone.

9.0 Land Base

9.1 Forest Cover Inventory

The forest cover inventory is a key component to the timber supply review of the TSA. The history of the forest cover inventory in the Cranbrook TSA can be summarized briefly as:

- The forest cover was formally updated for disturbances to December 2000, except for the 82F/82J blocks that have been updated to December 2001. The resultant database used in the analysis was further updated for disturbances to Jan 2003 using licensee data for logged areas.
- The forest cover attributes have been projected to January 1, 2003
- An audit of the inventory was completed in the late 1990's and showed that natural stand volumes in the TSA were overestimated by the inventory by 5%, though the difference was not statistically significant.
- The volumes associated with partially harvested stands within the inventory (history record shows a % logging history) have been adjusted to account for over-prediction of volumes by VDYP. VDYP does not accurately reflect volume removal in partially harvested stands, so a manual adjustment to the volumes, to reduce them by the area disturbed, has been performed on these stands. (Refer to section 11.5 for more detail.)
- The last forest cover inventory for the TSA was completed in 1992 using 1988 photos. Since then, periodic updates for disturbances, and projection of time-dependent attributes have occurred.
- The current inventory exists in tables that have been 'Rolled Over' into INCODSADA from an FC1/FIP inventory. (No new data – simply FIP data in new MS Access tables)

9.2 Thematic Data Sources

Issue or Data	Description, Source	Coverage Name	Version or Date Stamp
Administrative Linework			
Landscape Units	Landscape Unit Boundaries, MSRM Nelson	DCB_LU	2002
Planning Cells	Important watersheds for management constraints, MSRM Nelson	DCB_PCELL	2000
Operability	Operability Line finalized in 2003, Forest District staff	DCB_OP_2003	2003
Ownership	Ownership, MSRM Nelson updated by Forsite	TSR3_OWN	2003
Inventories			
BEC Variants	Biogeoclimatic Variants, MSRM Nelson	DCB_BEC	2002
NDT Types	Natural Disturbance Types calculated based on BEC, Forsite	DCB_BEC	2003
Slope Classes	0 – 40%, 41 – 70%, 71 – 80%, and >80% slope classes, MSRM Nelson	DCB_SLP_BR	2002
Forest Cover	Forest Cover for Forest District, Victoria Data Warehouse	DCB_FC_2003	Aug 2003
Park Forest Cover	Forest Cover for Purcell Wilderness (82F097-099), MSRM Nelson		1997
Terrain Classification	Terrain Classification, TEMBEC, Galloway, BCTS	TERRAIN	Sep-03
ESA's	Environmentally Sensitive Areas, previous version of Forest Cover	DCB_FC_2003	1992
Management Guidelines			
Connectivity Corridor	MSRM Nelson	DCB_COR	1999
BEO's	Biodiversity Emphasis Option, assigned using new BEC and HLP logic	DCB_TSR_BEO	2003
Watersheds	Community and District Watersheds, MSRM Nelson	DCB_CWS_DWS	2000
Ungulate Winter Range	KBLUP-IS Ungulate Winter Range, MSRM Nelson	UWR_KBLUP2	1998
Fire Maintained Ecosystem Restoration	Ecosystem Restoration plans from Forest District. TSR2 algorithm based ER mapping used to fill voids.	DCB_FMER	1997-2002
Caribou Classification	KBHLPO Caribou habitat management areas, MSRM Nelson	DCB_CARI_DIS / DCB_CARIB	
Visual Quality Objectives	Visual areas and objective, Forest District	VQO_DCB	Aug-03
OGMA / MMA's	Old growth management areas and mature management areas generated by Forsite. SRMMP plan provided areas for 6 LU's.	DCB_POGMA_MAT	2003
Lake Management Zones	All L1 lakes not NDT 4 buffered 200m, Forsite	DCB_LMZ	2003
Riparian Network	Rivers, wetlands buffered according to classification see details in data package, Forsite	DCB_BUFFERS	2003
Enhanced Resource Development Zones	MSRM Nelson	DCB_ERDZ	2002
Transportation Network	Roads, Pipelines, Railways buffered see details in data package, Forsite	DCB_BUFFERS	2003
Other / Special			
Forest Fires	2003 Forest Fires, MSRM	DCB_FIRES03	Sep-03
MPB Hazard	Regional IBD hazard shapefile, MSRM Nelson	BEETLE_HAZ	2002

9.3 Exclusions from the Crown Forested Land Base

9.3.1 Ownership classes not part of the TSA

The area of the Rocky Mountain Forest District is divided into ownership codes that describe the nature of ownership of a particular parcel of land. For forest management in the Cranbrook TSA, only those lands that are a provincial crown ownership contribute to forest management objectives, like landscape–level biodiversity. Only those lands coded for timber management (coded as '-C') contribute to timber harvesting activities. Parcels of land coded as non-contributing ('-N') are treated as timber harvesting land base removals. Table 23 below describes the various ownership codes in the Cranbrook TSA, and their contribution to the Crown Forested Land base, the Timber Harvesting Land base, or both.

Table 23. Ownership codes and application in TSR3

Ownership Code	Description	% Contribution to Crown Forested Land base	% Contribution to Timber Harvesting Land base	Total area (hectares)
51-N	National Parks	0%	0%	0
60-N	Ecological Reserves	100%	0%	56
61-C	U.R.E.P Reserves – contributing (>100 ha)	100%	100%	1,046
61-N	U.R.E.P Reserves – non-contributing (<100 ha)	100%	0%	953
62-C	Forest Management Unit	100%	100%	1,112,121
62-N	Timber Agreement Lands	100%	0%	750
63-N	Provincial Park Class A	100%	0%	59,983
65-N	Provincial Park Class C	100%	0%	26
67-N	Provincial Park	100%	0%	13,993
69-C	Misc. Reserves – contributing (>100 ha)	100%	100%	54,207
69-N	Misc. Reserves – non-contributing (<100 ha)	100%	0%	1,217
75N	X-mas Tree Permit	0%	0%	5,826
77N	Woodlot License	0%	0%	8,247
99N	Misc Leases	0%	0%	82
All Others	Federal lands, private land, First Nation Reserves, Dominion Gov't Lands	0%	0%	225,797

The current ownership layer was provided by the Ministry of Sustainable Resource Management in Nelson, BC. The ownership is considered current to 2003 and includes newly established woodlots within the TSA and the removal of the Flathead Townsite (private land). Additional edits were made for:

- The area known as the 'CPR Lands', in the Lower Elk Landscape Unit, was confirmed to be in provincial crown ownership. This area has been added to this analysis, increasing the size of the crown forested land base by approximately 699 ha.
- Areas around established ski resorts, the Flathead Town Site and issued woodlots were confirmed to be excluded from the timber harvesting land base as per TSR2.
- Areas of 61-N and 69-N (see the above table) that were greater than 100ha, were changed to 61-C and 69-C respectively. Similarly, areas of 61-C and 69-C that were less than 100ha, were changed to 61-N and 69-N. This reflects the reduced timber harvesting opportunity in and around these smaller recreation features in the Cranbrook TSA. Other consideration for recreation within the TSA will also be covered by visual quality management and forest cover requirements for recreation in high value recreation corridors.
- An area of private land (Tembec's MF 27) in the St Mary's drainage was added into the resultant because it was absent from the ownership coverage.

9.3.2 Non-forest and non-productive forest

The forest cover inventory used in this analysis originated in the late 1980's as a reinventory project using the FIP/FC1 inventory standard at the time. The inventory has since been 'rolled-over' into the newer VEG format of forest cover inventory (in 2001), but still retains the basic attributes of the original inventory, like non-productive descriptor. The non-productive descriptor (see the table below) was used to reduce the land base of the TSA for areas that are not capable of growing productive forest stands.

Table 24. Non-forest area

Code (NPD_CD =)	Description (NPD_DESCRP =)	Percent Reduction	Total area (hectares)
02	Alpine	100%	228,492
03	Rock	100%	16,837
06	Gravel	100%	6
09	Clay	100%	315
10	Alpine Forest	100%	78,559
11	Non-Productive Brush	100%	13,638
12	Non-Productive	100%	52,456
13	Non-Productive Burn	100%	20,230
15	Lake	100%	11,196
18	Gravel Bar	100%	41
25	River	100%	6,048
35	Swamp	100%	4,182
42	Clearing	100%	15,412
50	Road	100%	26
54	Urban	100%	17,699
62	Meadow	100%	1,279
63	Open Range	100%	28,915
Total			**495,333**

9.3.3 Non-commercial cover

Non-commercial cover is productive forest land that is otherwise occupied by non-commercial tree or shrub species. This area of land does not currently grow commercial tree species, and is not expected to do so without intervention. This area is therefore excluded from the crown forested land base.

Table 25. Non-commercial cover

Description	Percent Reduction	Area excluded (ha)
Non-Commercial Brush (NF Desc=NCBr)	100%	3,474

9.3.4 Backlog NSR - unproductive sites

Backlog NSR (Not Satisfactorily Restocked) areas identified in TSR2 have been subsequently reviewed by district staff and significant proportions were reclassified. This resulted in areas being either removed from the land base, areas being classified as restocked, and areas being confirmed as actual NSR. The portion of the Backlog NSR that was designated to be removed from the land base resulted from unacceptable economics associated with bringing these sites back into production.

Table 26. Backlog NSR - unproductive sites

Description	Percent Reduction	Area excluded (ha)
NSR-Unproductive	100%	525

9.3.5 Roads, trails, and landings

Quantifying the area that is, and will be, disturbed by roads, trails, landings (RTLs) and other access features in the TSA is an important part of determining the THLB. Area that was expected to remain non-productive was removed from the working land base as outlined below.

9.3.5.1 Classified roads

Classified roads are those roads identified in the forest cover inventory. These roads are frequently very large roads or highways with a wide right-of-way. This area is removed from the THLB based on coding in the forest cover file. See Table 24 for a review of the codes netted out of the forested land base – roads typically fell under the "Urban" category.

9.3.5.2 Unclassified roads, trails, and landings

Right-of-way widths were determined through discussions with knowledgeable Licensee and Ministry staff[45] and by reviewing values used in previous east Kootenay TSRs. Because of the similarities in the Invermere and Cranbrook units, attempts were made to be consistent between the two TSAs. Road widths in Table 27 represent an average unproductive width for each of the road types shown. Widths for railways and power lines were taken from the Cranbrook TSR2 analysis.

A complete roads layer for the TSA was developed in 2003 by adding recently constructed roads to an existing district roads coverage. Each road was assigned a type and then buffered to the widths shown below. The buffered areas are considered unproductive and are netted out of the crown forested land base.

Table 27. Access feature classification

Access feature/ class	Road length (km's)	Road width (meters)	Percent Reduction	Gross Area	Area deducted (ha)
Highway	928	40.0	100%	22,908*	13,821
Secondary Road	1,461	15.9	100%		
Logging Road	16,422	8.5	100%		
Trail	25	3.0	100%		
Railway	465	33.8	100%		
Power Line	777	49.0	100%		
Pipeline	301	30.8	100%		

Note: Overlap between these features and non-forested areas in Table 24 exist but no double counting occurs during netdowns.

* This gross area is less than the area obtained by multiplying road lengths and widths. This is because the GIS coverage does not double count overlaps between feature types or the buffer overlaps that occurs at all intersections.

Based on estimates provided by the Regional Pedologist for TSR2, reductions to account for in-block trails and landings were defined as shown in Table 28. These estimates take into account varying practices that have occurred during different time-periods in the TSA. The percentage values for trails and landings remain unchanged from TSR2. These percentages were translated into equivalent areas (i.e. 5.76% of logged area - 140,399 = 8087 ha) and then applied spatially through enlarged buffers on existing logging roads. The total netdown for existing roads, trails, and landings can be found in the table below.

Table 28. Unclassified roads, trails, and landings

Feature Type	Total area (ha)	Reduction percent (%) (applied to existing harvested areas)	Area deducted
Roads / Rail / Power / Pipeline	22,908	Area 100% removed as defined in Table 27.	13,821
In block Trails	17,247	5.76% (deducted from all previously harvested stands).	8,807
In block Landings	11,108	3.71% (deducted from all previously harvested stands)	5,208
Total	**51,263**		**27,836**

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[45] Mike Black / Gary Dolynchuk / Greg Anderson, Ministry of Forests, Cranbrook, BC. Pers. Comm. September 16, 2003

9.4 Exclusions from the Timber Harvesting Land base

9.4.1 Inoperable/inaccessible

Inoperable areas are areas that are not available for timber harvesting because of physical limitations or unsuitable economics resulting from steep slopes, unfeasible road access or uneconomic yarding or flight distance. In the Cranbrook TSA, operability was reviewed in 2003 by forest licensees and the BC Ministry of Forests[46]. The new operability line more accurately excludes stands that are uneconomic to access or are physically impossible to access with current technology. As a result, the operable land base has decreased in size since the last timber supply review.

In addition, any slopes > 70% inside the operable area will be excluded from the timber harvesting land base. Slopes > 70% are typically not utilized in this TSA and are therefore not considered harvestable with current technology. After discussions with licensees and the MoF, the 65% maximum slope for pine leading stands (from TSR2) was removed in order to provide consistency for all species in the TSA.

Table 29. Inoperable land base

Criteria	Percent Reduction	Crown forested land base (hectares)	Area excluded (hectares)
Physically and economically inaccessible with current technology (from operability coverage)	100%	256,408	238,714
Slopes > 70%	100%	9,724	257
Total		**266,132**	**238,972**

9.4.2 Environmentally sensitive areas

Environmentally sensitive sites and areas of significant value for other resource uses were delineated within the forest cover inventory as Environmentally Sensitive Areas (ESA's). ESA's are a broad classification of areas that can appear to be sensitive for unstable soils (E1s), forest regeneration problems (E1p), snow avalanche risk (E1a), and high water values. (E1h). Netdowns associated with regeneration problems, avalanche risk, and water values are shown in the table below.

Since the last TSR in the Cranbrook TSA, ESA1 soils mapping has been replaced with level B and level D Terrain Stability mapping throughout the operable land base. Terrain stability mapping is considered to provide a better estimate of the extent of unstable soils than the ESA mapping. The use of Terrain Stability mapping is described in the next section.

Table 30. Area reductions for Environmentally Sensitive Areas

ESA category	ESA description	Total Crown forested land base area (ha)	Percent reduction	Area excluded (ha)
E1a	Severe snow avalanching	254	**100%**	77
E1h	High water values	104	**100%**	103
E1p (outside NDT 4)	Severe regeneration problems caused by biotic factors	59,766	**100%**	7,161
Total		**60,937**		**7,341**

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[46] Gary Dolnychuk (MoF), Brian Dureski (Tembec), Ken Streloff (Tembec)

9.4.3 Unstable Terrain

Tembec, Galloway, and BC Timber Sales have now completed terrain stability mapping for areas of concern in the TSA. Mapping was completed in a variety of projects to various intensities of mapping (Level B and D); largely to satisfy operational and regulatory requirements. Spatial coverages from the numerous licensee terrain mapping projects were appended together into a single layer. The stability attribute from all the separate inventories were compiled into a 'Final_Class' attribute, where the stability class from the most intensive mapping, was given precedence over the least intensive mapping when overlaps occurred.

As this data was considered more accurate than ESA mapping, it eliminated the need for ESA soils mapping (described above) for determining unstable terrain. The netdowns below represent the best knowledge about the extent of unstable terrain in the TSA and are meant to capture those areas where logging is completely excluded. There is an acknowledgement that the classes assigned in the terrain mapping are further refined in the field during cutting permit development. For example, a portion of the polygons mapped as "unstable" or "partially unstable" are typically confirmed to be acceptable for timber harvesting in the field. These mapped classes serve as a red flag for field operations and do not automatically exclude these areas from harvest. Based on field experience in the Cranbrook TSA, Table 31 shows the approximate proportion of each class that will be removed from the land base.

Table 31. Field based interpretations to be applied to terrain mapped polygons

Mapped Terrain Class	Confirmed Unacceptable for harvest in the field	Confirmed Acceptable for harvest in the field
U (unstable)	90%	10%
P (potentially unstable)	5%	95%

Notes: Based on input from Tembec field staff based on their experience with Level D Terrain Mapping in the Cranbrook TSA.

For purposes of modeling, netdowns were performed as per Table 32 – all polygons labeled as V or U and all IV polygon inside community watersheds were removed. This subset of the terrain mapped polygons resulted in a netdown of area consistent with field operations and also reflected the increased sensitivities that are present in community watersheds.

Table 32. Area reductions for unstable terrain

Mapped Terrain Class	Percent Reduction	Total Crown forested land base (ha)	Area Excluded (ha)
V (high mass wasting hazard) from Level B mapping	100%	835	262
U (unstable terrain) from Level D mapping	100%	11,109	3,981
IV in Community Watersheds	100%	5,231	1,628
Total		**17,175**	**5,871**

9.4.4 Non-merchantable forest types

Non-merchantable forest types are stands that contain tree species not currently utilized, or timber of low quality, small size and/or low volume. Non-merchantable types are generally entirely excluded from the timber harvesting land base. In the Cranbrook TSA, deciduous-leading (hardwood) stands are not considered economically viable. Similarly, licensees do not pursue whitebark pine-leading stands, as these stands tend to have poor wood quality. These stands were excluded entirely from the timber harvesting land base.

Decadent timber types (Cw or Hw or Bl leadings stands over 200 years old) were also removed from the land base because of economic uncertainty. A portion of these stands may be economic during good pulp markets but they have been removed because they balance out potentially small areas under 200 years old that may prove to be decadent / uneconomic.

Stands within parkland BEC variants[47] were not specifically excluded from the land base since the BEC variant mapping is coarse relative to the detailed stand level mapping available in forest cover data. Forest stand attributes were used to remove stands not suitable for harvesting. Forest cover data was used to develop a merchantability model that was one of the inputs used in developing the new operability line. Thus, most non-merchantable stands in at higher elevations are already excluded as inoperable/non merchantable. The remainder should be caught using stand specific attributes (low site index, marginal species) or other netdowns (slope>70%, unstable, ESAs, etc). There are 2585 ha or 7.6% of the 'upper' variants included in the THLB and 6 ha of parkland variants in the THLB. Appendix 3 provides a breakdown of area by BEC variant in the CFLB and THLB.

Table 33. Non-merchantable forest types

Species	Inventory type group	Percent Reduction	Total Crown forest land base (ha)	Area Excluded (ha)
Deciduous leading	35-42	100 %	11,778	8,154
Pa leading	28 (where Pa leading)	100 %	1,895	217
Cw/Hw leading	9-17 over 200 yrs old	100%	2,479	1,262
Bl leading	18-20 over 200 yrs old	100%	14,565	1,757
Total			**30,717**	**11,390**

9.4.5 Low productivity sites

Low productivity sites are areas that are not suitable for timber harvesting due to low timber growing potential. These stands have suitable species for timber harvesting but are not expected to contribute to the THLB because they take too long to grow a commercial crop of trees.

In the Cranbrook TSA, timber extraction is completed using different harvesting systems depending on the steepness of the site. On slopes >= 40%, more expensive ground based systems or cable harvesting are typically used. On slopes < 40%, conventional harvesting methods are used. In general, steeper slopes require a higher threshold of timber volume and piece size to be considered economic and this is reflected in a higher minimum site index threshold. Table 34 shows the minimum criteria that stands need to achieve in order to be considered part of the timber harvesting land base. It assumes that pine leading stands have a lower threshold for piece size and are more sensitive to increases in piece size with slope. Other species are not differentiated based on slope in the analysis (Table 34) but the values used reflect a weighted average of all conditions.

The minimum stand criteria are used to define the stands considered to be low sites are based on achieving timber products at a maximum stand age. Sawlog stands are generally reached by age 100 in lodgepole pine and age 120 in Douglas-fir, therefore maximum acceptable rotation ages are approximately 120 for pine and 150 for Douglas-fir. The criteria for low-site stands are also related to the Cranbrook TSA Problem Forest Type Targeted Inventory, March, 1998 – since stands above the low-site thresholds here are classified into problem forest types, extended rotation stands and sawlog stands in Section 9.4.6. The criteria in Table 34 are used to derive the minimum site index criteria in Table 35 – which are applied in the netdown as a reduction to the timber harvesting land base.

Table 34. Minimum stand criteria for timber harvesting

Leading species	Slope	Minimum Vol/ ha (m3/ha)	At Age
Pl Leading	< 40%	150	120
Pl Leading	>= 40%	200	120
Fd Leading	< 40%	100	150
Fd Leading	>=40%	150	150
Other	All	150	120

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[47] The new (2003) BEC variant line work has broken the old ESSF variants into regular, 'upper', and 'parkland' variants. For example, the old ESSFdk is now broken into the ESSFdk, ESSF dku, ESSFdkp.

Table 35. Low site netdowns

Leading species	Inventory Type Group Number	Site index	Slope (%)	Percent Reduction	Total Crown forested land base (ha)	Area excluded (ha)
Pl Leading	28-31	< 10.0	< 40	100 %	6,023	1,670
Pl Leading	28-31	< 12.0	>= 40	100 %	6,045	1,097
F leading except FS	1-3, 5-8	< 10.0	< 40	100 %	2,438	2,164
F leading except FS	1-3, 5-8	< 13.0	>= 40	100 %	12,603	1,328
FS, S, Pw	4, 21-26, 27	< 8	All	100%	17,688	2,372
All others	9-20, 32-34	<10	All	100%	15,072	2,951
Total					**59,689**	**11,582**

9.4.6 Problem forest types

Problem forest types are those stands that occupy sites that have the potential to produce merchantable timber but are currently not utilized due to marginal merchantability. These sites are removed from the working land base. In the Cranbrook TSA, a Problem Forest Type Partition has been created to encourage opportunities for the rehabilitation of these moderately dense pine stands and provide harvest opportunities for post and rail forest licensees. A statistically-based inventory project completed in 1998[48] determined the proportions of various suspect forest inventory types could be expected to contribute to the timber harvest of the Cranbrook TSA. See Table 36.

Table 36. Categories of Problem Forest Type

Category	Description
1	Contribute to a sawlog AAC (part of the regular AAC).
2	Contribute to a sawlog AAC with reduced volume expectations – as long as the stand rotations are extended. These stands needed additional years to reach sawlog size.
3	Truly problem forest types, and not otherwise merchantable as sawlogs. These remaining stands, where they are lodgepole pine leading, could contribute to a post and rail partition, but are deducted from the timber harvesting land base.

In this timber supply analysis, the area of problem forest type in category 3 (above) was removed from the timber harvesting land base. In recognition of the potential for alternative products (i.e. fence posts) being extracted from these stands, an AAC partition was established during TSR2. There has been almost no harvesting activity in this area since that time, so these stands will remain outside the THLB and subject to a separate partitioned harvest.

Areas that fall within category 1 or 2 above contribute to the regular sawlog AAC, based on normal or extended rotations. Stands that require extended rotations were created as separate analysis units, where the minimum harvest age is extended by 20 years to allow for additional time to reach merchantability and the volumes are reduced by 45% (from equivalent natural stands), to account for fewer sawlogs in these stands. The percentages in Table 37 are derived from the *Cranbrook TSA Problem Forest Type Targeted Inventory, March, 1998*. This project was completed by the Ministry of Forests to determine the proportions of suspect inventory types that belong to the categories defined in Table 36.

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[48] Cranbrook TSA Problem Forest Type Targeted Inventory, March, 1998. This project was completed by the Ministry of Forests to determine the proportions of the TSA land base that can contribute to potential sawlogs, extended rotations, or were truly non-merchantable problem forest types.

Table 37. Problem forest type definitions

Problem Forest Type Number	Species	Inventory Type Group	Age	Height	Category of Problem Forest Type (% area of identified inventory type)		
					3 (exclude)	2 (ext rot)	1 (regular)
1	Pl leading	28-31	> 40	< 10.5	6,134 ha (80%)	- (0%)	1,534 ha (20%)
2	Pl leading	28-31	>40 and <= 60	>= 10.5 and <= 19.4	5,684 ha (35%)	1,624 ha (10%)	8,933 ha (55%)
3	Pl leading	28-31	>60 and <= 80	>= 10.5 and <= 19.4	17,813 ha (18%)	23,570 ha (24%)	57,396 ha (58%)
4	Pl leading	28-31	>80	>= 10.5 and <= 19.4	8,871 ha (29%)	17,436 ha (57%)	4,282 ha (14%)
5	FPy, FPl, FDecid, Py	6, 32	>80	>= 10.5 and <= 19.4	343 ha (6%)	686 ha (12%)	4,690 ha (82%)
6	FPy, FPl, FDecid, Py	6, 32	41-60	>= 10.5 and <= 19.4	- (0%)	151 ha (11%)	1,221 ha (89%)
7	FPy, FPl, FDecid, Py	6, 32	61-80	>= 10.5 and <= 19.4	- (0%)	396 ha (12%)	2,908 ha (88%)
TOTAL					**38,845 ha***	**44,044 ha**	**80,963 ha**

* Areas provided represent gross areas. The area effectively removed by PFT's in the netdown hierarchy was 17,856ha. The area of extended rotation that remained in the THLB was 18,855 ha.

In applying these proportions in the analysis, the use of 'partial' netdowns was avoided. Stands that fell into each of the problem forest types below were sorted in ascending order of site index, and then polygons were netted out of the timber harvesting land base until the correct proportion is achieved. For example, for Problem Forest Type 1 above, all stands that met this description, were sorted in ascending order of site index, and the first 80% of the area was identified as Category 3 (excluded from the THLB) and the remaining 20% contributed to the THLB.

In order to support partition harvest level decisions, the PFT areas excluded from the land base were further reviewed to determine the area of PFT's that would be eligible to support a partitioned cut. The areas of PFT's that were excluded from the THLB for no other reason than a PFT definition fit this definition. This area is slightly less than the area of PFT netdown because of overlaps with WTPs and Riparian. Areas and volumes are summarized below.

Table 38. Problem forest type areas/volumes available to support a partitioned cut

	Area by Age Class						
	41-60	61-80	81-100	101-120	121-140	141-250	Totals
PFT 1	797	82					879
PFT 2	3,302	468					3,770
PFT 3		8,963	60				9,022
PFT 4			1,253	942	976	184	3,355
PFT 5			147	15	39	11	213
Total Area	4,099	9,512	1,460	958	1,015	195	17,239

	Volume by Age Class (m3)						
	41-60	61-80	81-100	101-120	121-140	141-250	Totals
PFT 1	2,592	1,978					4,570
PFT 2	194,773	34,211					228,984
PFT 3		721,346	5,265				726,611
PFT 4			91,151	107,089	150,359	30,987	379,586
PFT 5			5,711	1,140	1,897	791	9,539
Total Vol	197,365	757,534	102,127	108,229	152,256	31,777	1,349,289

9.4.7 Existing Wildlife Tree Patches

Existing wildlife tree patches have been excluded from current timber harvesting activities, and are expected to remain on the landscape for at least one rotation. An equivalent area of mature forest will always exist in WTP's so this area was removed from timber harvesting land base. A layer of existing wildlife tree patches was compiled from forest development plans from the TSA licensees. Further information on how wildlife tree patches are addressed in the analysis can be found in Section 11.6.

Table 39. Existing Wildlife Tree Patches

	Percent Reduction	Area Excluded (ha)
Existing Wildlife Tree Patches	100%	2,254

9.4.8 Riparian reserves and management zones — streams

A digital stream network was developed from many sources, to create the best possible representation of streams in the TSA. In 2000, MSRM[49] created a riparian reserve coverage from TRIM streams (some of which had been classified by Tembec), MWLAP Watershed Atlas data, and MWLAP Fish Presence data. This dataset identified riparian reserves associated with S1 – S3 streams (Riparian Management Guidebook, MoF 1995). This dataset was used in combination with a complete TRIM stream dataset for the TSA. Any known stream classifications (up to 2003) from Tembec and Galloway were utilized and where no information was available, the MSRM coverage was used to assign a general 'S1-3' status. Any remaining stream reaches without a class were generalized into fish (assumed S4) and non-fish streams (S5-S6) based on gradient.

9.4.8.1 Riparian reserves

Riparian reserves around streams in the Cranbrook TSA were excluded from the timber harvesting land base. Reserve zone widths for the various stream classifications are shown in Table 40. These areas were excluded from timber harvesting activities to preserve the integrity of the streams and protect any resident fish populations.

9.4.8.2 Riparian management zones

Management practices within riparian management zones also result in area exclusions from the timber harvesting land base. As per the best management practices recommended in the *Riparian Management Area Guidebook*, a portion of the volume/area of these zones was excluded from the THLB. This is achieved by an "effective" riparian buffer width that was 100% excluded. This width is made up of the reserve zone and a portion of the management zone representative of the intended % volume retention. See Table 40 for a description of the riparian management netdown assumptions.

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[49] Eric Valdal, MSRM Nelson GIS specialist, pers com Oct 2003.

Table 40. Riparian reserve and management zones — streams

Riparian class*	Stream length (km)	Reserve width (m)	Management zone width	Management zone retention (%)	Effective Buffer Width (m)** (both sides)	Percent Reduction	Percent Contribution to Biodiversity
S1	45	50	20	50%	60	100%	100%
S2	574	30	20	50%	40	100%	100%
S3	576	20	20	50%	30	100%	100%
S1-S3^	6,056				36	100%	100%
S4	3,655	0	30	25%	8	100%	100%
S5	622	0	30	25%	8	100%	100%
S6^^	1,378	0	20	5%	1	100%	100%
S5-6^	12,515				3.1	100%	100%
TOTAL	**25,425**						

* Stream classes are defined in the Riparian Management Guidebook. S1-S4 are fish bearing, while S5-S6 are non fish bearing.

** Effective width is calculated as Reserve Width (m) + (Management Zone Width x Management Zone Retention)

^ S1-3 reserve and management zone widths are based on a weighted average of 4%-S1, 48%-S2, and 48%-S3. S5-6 values are based on a weighted average of 30%-S5 and 70%-S6. These values were obtained from watersheds with known fish stream data in the Cranbrook data set.

^^ All buffer width except were include in the spatial resultant file except for the 1m buffers on S6 streams. This 275 ha of gross area was represented in the buffer width for the S5-6 streams.

9.4.8.3 Riparian reserve and management zones — wetlands and lakes

Lakes and wetlands in the Cranbrook TSA were extracted from forest cover and TRIM data, and classified in accordance with the *Riparian Management Area Guidebook* and the *Regional Lake Classification and Lakeshore Management Guidebook*. Similar to the riparian reserves around streams, a buffer coverage around each lake / wetland was created to represent the area deducted from the timber harvesting land base. See Table 41 below for the effective buffer width around each class of lake or wetland.

Large lakes (L1 lakes) will typically only have a narrow 10m reserve, or no reserve around them. A 200m lakeshore management zone is implemented around these large lakes and was be modeled using a forest cover requirement (see section 14.7) consistent with visual and recreation values. The exception to this is the large lakes in the NDT 4 natural disturbance type, where standard reserves apply. These lakes are surrounded by polygons to be managed as Open Forest or Open Range and NDT4 cover requirements take precedence.

Table 41. Riparian reserve and management zones — wetlands and lakes

Riparian class*	Waterbody Area (ha)	Reserve width (m)	Management zone width (m)	Management Zone Retention (%)	Effective Buffer Width (m)**	Reduction percent
L1 Lakes > 1000 ha (except lakes in NDT4)	6,171	0	200	15%	0 m	0 %
L1 Lakes <= 1000 ha (except lakes in NDT4)	4,081	10	190	15%	10 m	100 %
L2 Lakes	141	10	20	50	15 m	100%
L3 Lakes	725	0	30	50	15m	100%
L4 Lakes	5	0	30	50	15m	100%
W1 Wetlands	3,195	10	40	50	30m	100%
W2 Wetlands	92	10	20	50	20m	100%
W3 Wetlands	855	0	30	50	15m	100%
W4 Wetlands	2	0	30	50	15m	100%
W5 Wetlands	0	10	40	50	30m	100%
TOTAL	**15,267**					

* Refer to the "Forest Practices Code of British Columbia Riparian Management Area Guidebook, Tables 1, 2, 3" for classification guidelines. Lakes and wetlands have been extracted from the forest cover inventory, and TRIM, where it exists.

** Effective width is calculated as Reserve Width (m) + (Management Zone Width x Management Zone Retention). In the case of L1 lakes, the management zone is not part of the buffer because it is addressed through using forest cover requirements (section 14.7).

9.4.9 Wildlife habitat deductions – Identified Wildlife

The provincial *Identified Wildlife Management Strategy* provides for the creation of wildlife habitat areas (WHA) within the TSA, to protect key habitat features of listed wildlife species. No spatial land base deduction was implemented for Identified Wildlife because existing WHA's do not have timber supply impacts and proposed WHA's have not been made official.

Provincial policy states that WHA's can have a short-term AAC impact of up to 1%. At the time of this analysis, very few WHA's have been designated in the TSA, however it is recognized that an impact of up to 1% may be considered to account for the eventual deployment and establishment of WHA's.

In this analysis, no reductions were incorporated to address the potential 1% impact for IWMS. The likely impact of IWMS can be discussed by the Chief Forester in his AAC rationale.

Table 42. Estimates for wildlife habitat no harvest areas

Wildlife species	Percent reduction
Identified Wildlife Management Strategy	0 %

9.4.10 Cultural heritage resources

A cultural heritage resource is an object, site, or location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community, or an aboriginal people. Cultural heritage resources include archaeological sites, structural features, heritage landscape features and traditional use sites Archaeological overview assessments and Traditional Use Surveys are conducted as required to ensure the protection of cultural heritage resources. Many known archaeological sites occur in riparian areas that are already deducted from the timber harvesting land base, and where this does not occur, sensitive sites are currently protected using management practices such as wildlife tree retention, machine free zones, or winter logging. Experience demonstrates that in the timber supply analysis, most archaeologocal and cultural heritage concerns can be addressed by management practices and land base deductions for other factors. Existing netdowns and management practices provide a range of habitats, seral stages, plants and animals that support traditional uses of the land base. . As a result, additional land base deductions specific to cultural heritage were not applied in this timber supply review.

It is also recognized that ongoing treaty negotiations with First Nations will impact timber supply in the TSA. However, "current management" is the underlying assumption for the timber supply analysis and no treaty settlement has yet been reached Ktunaxa Kinbasket Treaty Council. The final results of treaty negotiations will be modeled in subsequent timber supply reviews as this information comes available.

9.4.11 Future roads, trails, and landings

Deductions for future roads are necessary to account for the unproductive area created as new roads, trails and landings are built. A first logging entry into any unroaded areas in the TSA will capture all of the timber volume available in that stand. Any subsequent entries will harvest less volume, recognizing the unproductive area that would then exist as roads, trails and landings.

Table 43 shows the estimates of unproductive area due to roads trails and landings in the future. These estimates are a reflection of the improved practices in the TSA, and are assumed to remain constant into the future. The estimate for future roads recognizes that much of the road infrastructure already exists in the TSA, thus lowering the net loss associated with accessing future harvesting areas.

Table 43. Future roads, trails, and landings

Feature Type	Reduction percent (%) (applied once to any future harvested areas)
Roads	3.0% (based on TSR2 road spacing and harvest system assumptions – but a 15.9m road width to be consistent with spatial netdowns)
Trail	1.9% (based on Regional Pedologist's summary of current practices for TSR2 – assumes all future bladed trails are restored to productivity.)
Landings	2.3% (based on Regional Pedologist's summary of current practices for TSR2).
Total	**7.2%** (applied as a volume reduction to Future Managed Stand yield tables)

The intention is to apply the deductions for future roads, trails and landings as a volume reduction to all yield tables for Future Managed Stands. However, this reduction is only applicable to stands that have not already had a reduction associated with existing roads, trails, and landings. Because a portion of the existing natural stands had already experienced this netdown (logged previously but not considered managed stands), the percentage was not applied again once these sites became managed stands. Thus, the portion of the future managed stands that would already have experienced the reduction was prorated against the portion that still required the 7.2% reduction – resulting in a 5.5% reduction to be applied to all future managed stands.
The application of this volume reduction was approximately equivalent to the removal of 19977 ha of THLB in the future. (5.5% of the existing natural stand area - 363,222 x 5.5% = 19977ha). When this area is added to the netdown for existing roads, trails, and landings (27,836 ha), a total land base impact of 47833 ha associated with roads, trails, and landings is realized. This represents 11.5% of the current THLB area.

10.0 Management zones and analysis units

10.1 Management zones and objectives

In order to accommodate the range of timber and non-timber resource objectives that occur within the TSA, forest cover requirements are applied within the timber supply model. These requirements maintain appropriate levels of specific forest types that are needed to satisfy objectives for wildlife habitat, visual quality, biological diversity, etc. Table 44 describes the types of management zones that occur in the TSA, while the specific forest cover requirements to be applied are discussed under Section 14.0, "Integrated Resource Management".

Table 44. Management Zone Definitions

Name	Crown Forested Area (ha)	THLB Area (ha)	Criteria used to delineate zone/group	Rationale/comments
High Biodiversity Emphasis Areas	111,426	45,202	Old Seral Goals: LU 14, 24 LU 2, 4, 23 (ESSF's only) LU 15 (Non ESSF)	Designated by the HLPO (Oct 2002) and the Southern Rocky Mountain Mgmt Plan (August 2003). Requirements exist to maintain old and mature forest for biodiversity. When retaining old and/or mature stands for biodiversity – connectivity corridors and grizzly habitat areas are given a high priority. LU's 14-18, 23-26, and a portion of 27 are within the SRMMP area. For the purpose of modeling old and mature retention, all of LU 27 will be treated as part of the SRMMP. In LU 2, the ESSFwm ceased to exist after the BEC mapping was redone in 2003 – and no similar variant exists, therefore, there is no Mature Seral goal for this area.
	55,585	17,992	Mature Seral Goals: LU 4 (ESSFwm's only) LU 14 (ESSFdk, MSdk only) LU 15 (ICHmk1,MSdk only) LU 23 (ESSFdk only)	
Intermediate Biodiversity Emphasis Areas	428,146	190,545	Old Seral Goals: LU 1, 3, 5-8, 12, 16-18, 20-22, 25-29, 36 LU 13, 15, 31 (ESSF's Only) LU 23 (MS Only) LU 33 (PP Only)	
	40,064	20,485	Mature Seral Goals: LU 18 (MSdk only) LU 22 (MSdk, ESSFdk only)	
Low Biodiversity Emphasis Areas	221,018	180,448	Old Seral Goals: LU 9, 10, 11, 19, 30, 32, 34, 35, 37, 38 LU 2, 4, 13, 31, (Non ESSF's) LU 33 (IDF)	
	4,219	2,928	Mature Seral Goals: LU 9 (ESSFwm, ICHmk1 only)	
Connectivity Corridor	354,580	190,186	Mapped Connectivity Corridors	
High Value Grizzly Habitat	-	-	Mapped High Value Grizzly Habitat (SRMMP area)	
Caribou	47,361	31,034	Mapped Caribou Areas (Priority 1 and 2)	Designated by the HLPO (Oct 2002). Requirements exist to maintain old and mature forest for habitat.
Ungulate Winter Range	204,150	157,074	Mapped Ungulate Areas (KBLUP) with specific species associations (Mule Deer, White Tail, Moose, Elk).	KBLUP-IS and DM/DEO direction for 2002 FDP's. Requirements for mature forest exist.
Community Watersheds	41,132	21,009	Mapped Community Watersheds	KBLUP-IS, FPC. Water quality, quantify and timing of flow is to be maintained.
Domestic Watersheds	87,351	50,550	Mapped Domestic Watersheds	KBLUP-IS. Water quality, quantify and timing of flow is to be maintained.
Fire Maintained Ecosystem Restoration	104,672	91,928	Ecosystem Restoration Plans provides management objectives for 49% of the NDT4 (Open Range / Open Forest / Managed Forest). The algorithm used in TSR2 was used to fill in any voids in mapping (51%).	Designated by the HLPO (Oct 2002) with more detail in the KBLUP-IS.

Name	Crown Forested Area (ha)	THLB Area (ha)	Criteria used to delineate zone/group	Rationale/comments
Enhanced Resource Development Zone (ERDZ)	129,549	105,183	HLPO ERDZ Map (based on old THLB definition)	Designated by the HLPO (Oct 2002). Has reduced green-up guidelines to maximize timber production.
High Value Watersheds and Special Areas	26,487	9,611	Wigwam – Wigwam LU (Upper Wigwam River) Mark Creek – Planning Cells K15, K20, K30, K35, K40, K41	DM/DEO Designation Mark Creek Integrated Watershed Mgmt Plan
Visual Areas: Retention Partial Retntn Modification	 12,747 91,517 20,429	 3,188 59,450 17,131	Mapped VQO polygons plus front / mid/ background viewing distances established from major highways/towns (as per KBLUP-IS Front Country Guidelines).	DM in letter dated Mar 14/03 established VQO's and referenced KBLUP-IS Front Country Visual Management Guidelines.
Integrated Resource Management	569,009	257,645	All areas outside of Open Range (FMER), Open Forest (FMER), and ERDZ areas.	Designated by the HLPO (Oct 2002). Has a min green-up guideline.

Areas within the TSA are often subject to several overlapping management objectives. For example, a stand in a High Biodiversity landscape unit may also be within an ungulate winter range area and a visually sensitive area. Overlapping objectives are modeled in a way that only allows stands to be harvested when all forest cover requirements have been satisfied. This involves the use of spatially unique 'zones' that are amalgamated into 'groups' that have forest cover requirements associated with them (FSSIM terminology).

10.2 Analysis units

To reduce the complexity and volume of information in the timber supply analysis, individual stands were aggregated into 'analysis units' based on dominant tree species (inventory type group), timber growing capability (site index), and silvicultural management regimes. For example, all spruce/balsam stands on moderate growing sites with a clearcut silviculture regime were grouped into a single analysis unit. Each analysis unit has an associated yield table that provides the model with the net merchantable volume available for harvest at various stand ages.

Three *sets* of analysis units were created to reflect the level of forest management associated with various time frames.

Existing Natural Stands (100 series)

Stands where forest management (planting/spacing) has been generally absent. This was defined as stands greater than 20 years old with no record of planting or spacing in the forest inventory files. This approach was agreed to by DFAM and the MoF as it best describes how stand management has historically been practiced in the TSA and is more conservative than the 30 year-old threshold used in TSR2.

Existing Managed Stands (500 series)

Stands where forest management (e.g. planting/spacing) has had a positive impact on the regeneration/growth of the stand. This was defined as stands harvested on or after 1982 (42,984ha) (<= 20yrs old) plus any stands harvested prior to 1982 (10,896ha) that have records of planting or spacing in the forest inventory files. This set of analysis units was meant to capture past regeneration practices in the TSA that should provide at least a modest improvement over natural stand volumes. Once harvested these stands were grown with similar expectations to the future managed stands described below.

Future Managed Stands (200 / 600 series)

Stands harvested from today forward. Once existing natural stands were harvested in the model, they were assigned to one of these analysis units. They were meant to capture the management/regeneration practices occurring in the TSA today.

Table 45. Analysis Unit Descriptions: Existing Natural Stands

Analysis unit	Existing Natural Stands AU #	Future Managed Stands AU#	THLB Area (ha)	SI Wtd Avg	Variable used to define analysis unit			Rationale / Comments
					Inv type groups	Site index range	Slope range %	
FdPy, Py	101	201	1,782	15.8	6, 32	All	All	Partial Cutting Regime - Not OR or OF
FdPy, Py - Ext Rotation	102	201	90		6, 32	All	All	Problem Forest Types in AU 101
FdOthers – Poor	103	203	7,193	12.2	1-5,7,8	<14	All	CC with Reserves
FdOthers – Mod	104	204	16,088	15.3	1-5,7,8	14 to <18	All	CC with Reserves
FdOthers – High	105	205	9,340	19.8	1-5,7,8	18+	All	CC with Reserves
SB – Poor	106	206	19,048	11.2	18-26	<14	All	CC with Reserves
SB – Mod	107	207	28,705	15.2	18-26	14 to <18	All	CC with Reserves
SB – High	108	208	12,618	20.4	18-26	18+	All	CC with Reserves
CH (All Sites)	109	209	1,662	15.0	9-17	All	All	CC with Reserves
Pl Poor – slopes 0-40%	110	210	7,125	12.0	27-31	<14	0-40	CC with Reserves – GB Harvest
Pl Mod – slopes 0-40%	111	211	55,701	15.9	27-31	14 to <18	0-40	CC with Reserves – GB Harvest
Pl High – slopes 0-40%	112	212	62,973	19.7	27-31	18+	0-40	CC with Reserves – GB Harvest
Pl Ext Rotation	113	213	17,734	14.1	27-31	All	0-40	Problem Forest Types in AU 110-112
Pl Poor – slopes >40%	114	214	1,386	12.7	27-31	<14	>40	CC with Reserves – Cable Harvest
Pl Mod – slopes >40%	115	215	8,142	15.7	27-31	14 to <18	>40	CC with Reserves – Cable Harvest
Pl High – slopes >40%	116	216	6,603	19.4	27-31	18+	>40	CC with Reserves – Cable Harvest
Lw – Poor	117	217	4,807	12.0	33-34	<14	All	CC with Reserves / Seedtree
Lw – Mod	118	218	18,225	15.7	33-34	14 to <18	All	CC with Reserves / Seedtree
Lw – High	119	219	21,506	19.7	33-34	18+	All	CC with Reserves / Seedtree
FMER-OR	150	N/A	18,593	13.8	All	All	All	FMER Open Range - single entry
FMER-OR – Extended Rotation	152	N/A	790		All	All	All	Problem Forest Types in AU 150
FMER-OF	151	251	41,113	15.0	All	All	All	FMER Open Forest - Part cut regime
FMER-OF – Extended Rotation	153	251	979		All	All	All	Problem Forest Types in AU 151
TOTAL			362,203					

Table 46. Analysis Unit Descriptions: Existing Managed Stands

Analysis unit	Existing Managed Stands AU #	Future Managed Stands AU#	THLB Area (ha)	SI	Variable used to define analysis unit			Rationale / Comments
					Inv type groups	Site index range	Slope range %	
FdPy, Py	501	601	325	15.8	6, 32	All	All	Partial Cutting Regime
FdOthers	502	602	3,277	15.7	1-5,7,8	All	All	CC with Reserves
SB	503	603	12,919	15.1	18-26	All	All	CC with Reserves
CH	504	604	166	16.6	9-17	All	All	CC with Reserves
Pl – Slopes 0-40%	505	605	30,690	16.5	27-31	All	0-40	CC with Reserves
Pl – Slopes >40%	506	606	1,930	16.6	27-31	All	>40	CC with Reserves
Lw	507	607	4,683	16.8	33-34	All	All	CC with Reserves / Seedtree
TOTAL			53,990					

The pine leading stands have been split into analysis units differentiated by slope. The gentler slope AU's were intended to represent ground based harvesting sites, while the steeper slope AU's were intended to represent cable harvesting sites that require longer minimum harvest ages to achieve merchantable piece sizes. This differentiation by slope was only applied to Pl stands since Pl stands had lower minimum piece size requirements on gentler slopes than other species (20cm vs. 25cm). Current practices indicate that harvesting 20cm Pl trees on gentler slopes is economically viable, whereas harvesting 20cm trees of any species on steeper slopes is not economically viable – given the higher costs of these harvesting techniques. For steeper slopes, a minimum piece size of 25cm is required for all species. The extended rotation pine AU contains stands identified in the Cranbrook Forest District Problem Forest Type Summary Report, 1999.

The FdPy/Py analysis units (101, 102) were intended to mimic the short-term shelterwood regimes used on the hot, dry sites in the NDT 4. Overstory trees are retained to provide shade for seedling establishment but are then removed within 10 years – thus this regime is modeled as a clear-cut with natural regeneration. The extended rotation version of this AU contains stands identified in the Cranbrook Forest District Problem Forest Type Summary Report, 1999 and have reduced volumes. These AU's do not include areas mapped for Open Range or Open Forest ecosystem restoration treatments. Modeling details are provided in Table 47 with volumes shown in the graphs below and in Appendix 5.

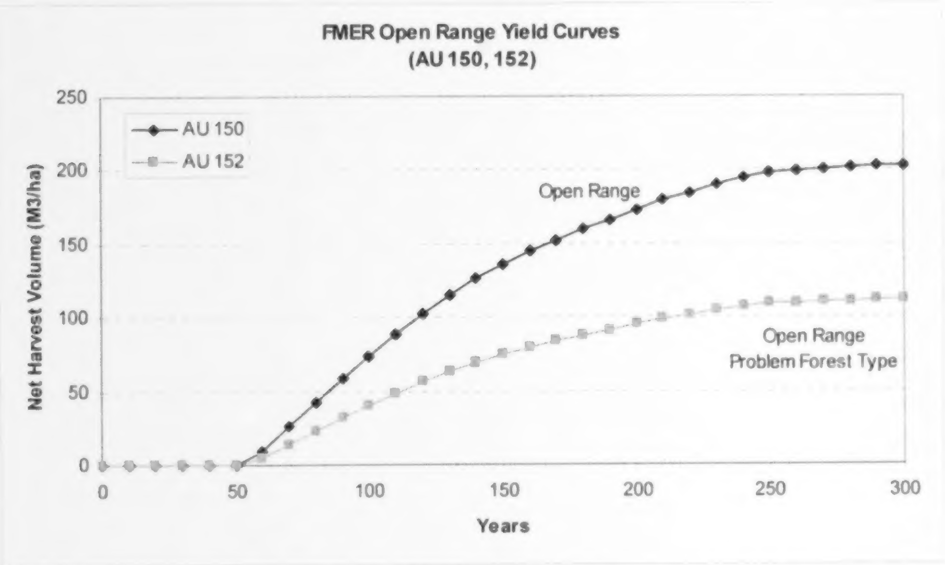

Figure 50. Open Range Ecosystem Restoration Yield Curves (regular and problem forest type)

The FMER-Open Range analysis unit (150) reflects a one time volume removal for ecosystem restoration purposes (Figure 50) where a 20 m3/ha of mature volume is retained on site (Table 47). Excess volume is removed to restore these sites to historical stand densities and then frequent low intensity fires are expected to maintain the open nature of these stands. Modeling details are provided in Table 47 with harvest volumes shown above and in Appendix 5. AU 152 is identical to AU 150 but reflects a 45% volume reduction attributed to its problem forest type designation.

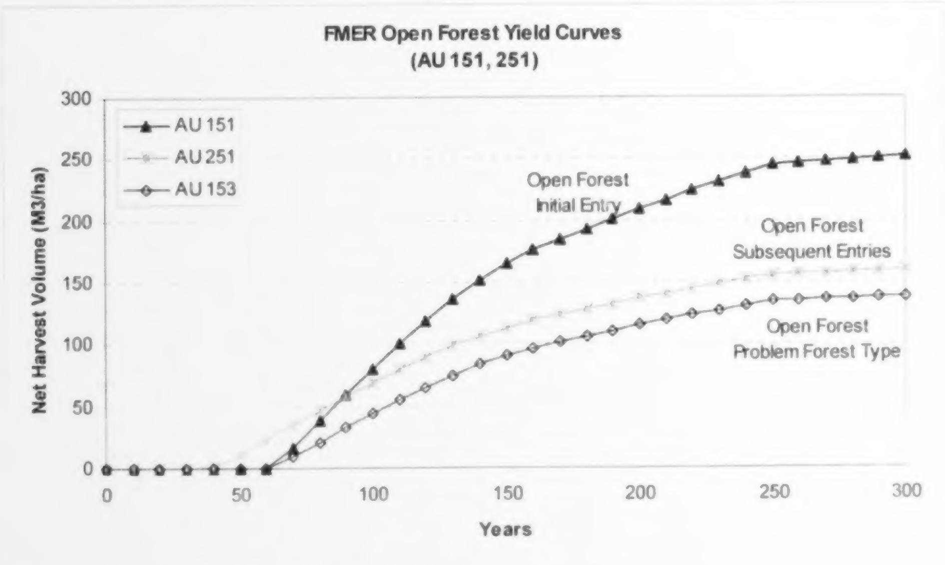

Figure 51. Open Forest Ecosystem Restoration yield cuves

The FMER-Open Forest analysis unit (151) reflects a commitment in KBLUP-IS and the HLPO to maintain a portion of the NDT4 in Open Forest conditions. This analysis unit is designated for an initial harvest that opens up these stands to historic densities, followed by periodic low volume harvests aimed at providing both range and timber. The first entry into these stands retains a 1/3 of the largest trees (~50m3/ha) and they were assumed to occupy 1/3 of the available growing space. The naturally regenerated future stands (AU 251) were thus modeled at 66% of the VDYP yields less factors for overstory shading and losses for roads. Shading reductions were calculated as 0.5% for each % of volume retained (33%x0.5=16.5%). The standard road loss of 5.5% was also applied. This resulted in a 49.5% total reduction from the regular VDYP curve for these sites. Modeling details are provided in Table 47 with volumes shown in the graph above and in Appendix 5. AU 153 is identical to AU 151 but reflects a 45% volume reduction attributed to its problem forest type designation.

Table 47. Partial cutting modelling parameters

	Open Range Restoration	**Open Forest**		**FdPy Shelterwood**	
		Initial Entry	**2nd+ Entries**	**Initial Entry**	**2nd+ Entries**
Regular AU#	150	151	251	101	201, 501
PFT AU#	152	153	251	102	201
Area	19659 ha	42173 ha		1873 ha	
Min Harv Age	120 yrs	110	110 yrs	100 yrs	100 yrs
Stand Vol @ MHA *	123 m3/ha	150 m3/ha	129 m3/ha	141 m3/ha	141 m3/ha
Retention Volume *	20 m3/ha	50 m3/ha	50 m3/ha	0 m3/ha	0 m3/ha
Harv Vol @ MHA *	102 m3/ha	100 m3/ha	79 m3/ha	141 m3/ha	141 m3/ha
Re-Entry Cycle	n/a	n/a	every 110 yrs	n/a	every 100 yrs
MAI	1.03	1.36	0.72	1.41	1.41
Yield Model	VDYP	VDYP	VDYP	VDYP	VDYP
Modeled SI	13.8	15	15	15.8	15.8
Modeled CC	35%	55%	55%	55%	55%
Modeled Species	FdPyPlLwSe	FdPyPlLwSe		FdPyLwPl	
Yield Reductions Modeled:					
Partial cutting effect & Rds	0.0%	0%	49.5%	0%	5.5%
Problem Forest Type	n/a	45%	n/a	45%	n/a

11.0 Growth and Yield

This section describes the information/data sources, assumptions, and methods for generating growth and yield estimates for both existing and future stands, under both unmanaged and managed conditions.

11.1 Site index

Estimates of site productivity were required to predict the rate of growth that will occur on each site throughout the TSA. The height of a "site" tree at age 50 (measured at breast height) is one measure of site productivity and is commonly referred to as "site index". The forest inventory data used in this analysis includes estimates of site index derived from the current age and height of each stand, and estimated site index values where better data is available (stand surveys, ground based SIBEC data). Where estimated values were available in the inventory file, they were used over the derived site index values.

11.1.1 Site curves

For each tree species, site curves were available to illustrate the relationship between stand height and age for a range of site indices. This analysis used the standard site curves recommended by the BC Ministry of Forests in all cases. They are as follows:

Table 48. Site index source

Species	Source
Douglas Fir (Fdi) + (Pw, Py, Lw)	Thrower and Goudie (1992)
Lodgepole Pine (Pl)	Nigh (1999)
Western Red Cedar (Cw)	Kurucz (1985)
Western Hemlock (Hw)	Nigh (1998)
White Spruce (Sw) + (Se, Sx, Bl)	Nigh (1997)

Note: Species surrogates as used in TIPSY are indicated by the "+ (_)" in the species column.

11.1.2 Site index adjustments

No site index adjustments were used for the Base Case. A sensitivity analysis assessed the impact of adjusting managed stand site indices using ecological relationships (Section 6.6). The Site Index Biogeoclimatic Ecosystem Classification (SIBEC) system was used to provide updated site index estimates for all managed stands. A coarse Predictive Ecosystem Mapping (PEM) project was completed in 2002 to support the mapping of ungulate winter range in the East Kootenay's. This PEM has not undergone the required level of accuracy assessment to be considered for inclusion in a Base Case analysis, but was used to complete a SIBEC sensitivity analysis. The following procedure was used to adjust the site indices for the sensitivity analysis:

1. The Forest Cover/Analysis Unit coverage was merged with the PEM data and AU data,
2. The distribution of site series by BEC variant within each Analysis Unit was determined. Each PEM polygon has only one site series (no deciles) so the area of each resultant polygon was tallied toward the AU/BEC variants/Site Series totals.
3. For each of the input species used in the Managed Stand Analysis Units, a new site index estimate was calculated using an area weighted average of the SIBEC estimates associated with each of the SIBEC cells (Leadings species + BEC variant + Site Series) in the AU.
4. The new site index estimates were run through TIPSY to generate new volume curves and minimum harvest ages for each of the Managed Stand AU's.

11.2 Utilization level

Utilization levels define the maximum height of stumps that may be left on harvested areas, the minimum top diameter (inside bark), and the minimum diameter at breast height (dbh) of stems that must be removed from harvested areas. These factors are needed to calculate merchantable stand volume used in the analysis.

Table 49. Utilization levels

	Utilization			
Species	**Minimum dbh (cm)**	**Maximum stump height (cm)**	**Minimum top dib (cm)**	**Firmwood standard (%)**
Pl	12.5	30	10	50
All Others	17.5	30	10	50

11.3 Decay, waste and breakage for unmanaged stands

Decay, waste and breakage factors are applied to unmanaged stand yield tables to obtain net harvest volumes per hectare. The standard values incorporated into the Variable Density Yield Prediction (VDYP) model were utilized.

11.4 Operational adjustment factors for managed stands

Operational Adjustment Factors (OAFs) were applied in order to adjust potential yields generated by the TIPSY growth and yield model down to net operational volumes. This includes reductions for such things as gaps in stands, decay/waste/breakage, and endemic forest health losses.

There are two types of OAFs used in the TIPSY model. OAF 1 is a constant percentage reduction to account for openings in stands, distribution of stems or clumpiness, endemic pests and diseases, and other risks to potential yield. OAF 2 is an increasing percentage reduction that can be applied to account for decay, waste and breakage. OAF 2 is applied after OAF 1 and increases linearly over time from 0 percent at age 0 to the specified percentage at 100 years of age.

The OAF1 value used in this analysis was the model default of 15%.

The OAF2 value used in this analysis was be the model default of 5% plus an amount to reflect losses from root disease (e.g. Armillaria). BEC variants and leading species were used to identify hazard ratings for Armillaria.

Table 50. OAF2 Values

Leading Species	BEC Variants	Hazard Category	Additional OAF2 for Armillaria	Total OAF 2
Fd	Non ESSF	High	5.8%	10.8%
Pl	Non ESSF	Mod	3.7%	8.7%
Non Fd or Pl	Non ESSF	Low	0.0%	5.0%
All	ESSF	Low	0.0%	5.0%

A final OAF2 was calculated for each AU by determining the amount of area in each of the 3 risk categories outlined above and calculating a weighted average. These values are shown for each AU in Table 50. The additional OAF2 used to address root rot was developed from informed opinion of the Regional Pathologist, using information from research completed in the Salmon Arm area, and assumptions used in previous Timber Supply Reviews. The percentages reflect the proactive management occurring in the TSA to minimize losses. This consists of higher establishment densities, planting of mixed species and planting of lower risk species.

11.5 Volume reductions

Deciduous

Deciduous volumes are not currently utilized in the Cranbrook TSA. Thus, deciduous leading stands were removed from the THLB and any deciduous volumes in coniferous leading stands were ignored during the compilation of yield curves. Recently logged blocks (<20 yrs old) with a deciduous leading inventory label were allowed to remain in the analysis because the coniferous stems are likely to overtop the deciduous stems and form the next crop.

Whitebark pine

Whitebark pine (Pa) leading stands in the TSA have experienced significant mortality in recent history. Because this mortality is not captured in the inventory files and much of the remaining stands are generally unmerchantable, Pa leading stands were removed from the THLB. Where Pa forms a minor component of existing stands, its volume was left in the analysis because current practice is to log these stems when they are part of better quality stands.

Partially Logged Stands in the Inventory

A history of partial logging in the TSA has resulted in the forest inventory file containing a number of areas with a % disturbed indicator. The previous TSR recognized that the volumes associated with these stands were likely overestimated by the VDYP yield model because it is insensitive to the attributes used to describe the changes in these stands. The following was done to address the issue:

Stands slated for partial cutting regimes in the NDT4 (FdPy, Open Range, Open Forest), had volume estimates determined based on professional judgment supported by modeling. Historical partial harvesting in these stands was one of the many considerations during the determination of these volumes. Partial harvesting was assumed to continue on these sites.

Partially harvested stands outside of the NDT4 are typically stands that were logged of their largest stems (IU logging) and stands that had "pine only removal" treatments. It is very unlikely that these stands will be partially harvested again. The majority of the area meeting this description was logged prior to the most recent reinventory (1988 photos), thus the inventory attributes now reflect the residual stands as much as possible. Where high removals (60+%) occurred it appears that the attributes on the inventory file now reasonably reflect the new stand. Issues still exist when low to moderate volume removals left stands that were still dominated by trees from the original stand. This translated into inventory attributes that do not adequately reflect the volume loss on the site. For these stands, the level of disturbance (10%, 20%, 30%, etc.) was used to reduce the stand volume generated from VDYP. For example, a site with a 20% disturbance in its history had its VDYP volume reduced by 20%. These stand level adjustments were reflected in the yield curves.

11.6 In-block volume retention

Retention of merchantable volume in the form of patches and individual trees is a common practice within cutblocks in the Cranbrook TSA. Volume is retained to meet wildlife tree requirements and for a variety of other forest management considerations (visuals, UWR, seedtrees, beetle proofing, etc). The amount and location of this retention can directly affect timber supply. Where volume is left in the THLB, and there is no expectation to remove it before the start of the next rotation, it must be accounted for in the timber supply model as a yield reduction.

A study was initiated in an effort to quantify the amount of volume being retained in recently logged blocks in the Cranbrook TSA so that appropriate volume implications can be included in the DFAM Timber Supply Review (TSR3). The detailed report on this study was published as *Cranbrook Timber Supply Area In-Block Volume Retention Study FINAL March 2, 2004.* Based on the results of the study, a volume reduction of 2.7% was recommended for application in the Cranbrook TSR3 Base Case model to account for Wildlife Tree Retention and all other types of long-term stand level retention.

This result was based on professional judgement and familiarity with both the in-block retention study and the TSR3 model. For additional context, the GIS analysis that looked specifically at WTP impacts for TSR3 resulted in a 1.5% impact estimate. That analysis likely provides us with a theoretical minimum or lower bound on the in-block retention impact. The raw result of this study (5.6% impact) could be viewed as a potential upper bound on this impact, with the recommended value (2.7%) falling in between.

11.7 Other issues related to yield table development

Yield tables were derived for existing natural stands using VDYP Batch v6.6d. Yield tables were generated for each polygon and then aggregated into one table for each AU. Volume reduction factors were applied to specific polygons as described in section 11.5 of this document (partially logged stands, Backlog NSR stands with low volume expectations). Yield tables are included in Appendix 5.

All future managed stand AU's have an associated existing stand AU from which it inherited stands when they are logged. These future managed stand AU's used the area weighted site indexes from the appropriate existing stand AU's and the regeneration assumption outlined in this document. These values were inputted into TIPSY 3.0h to generate a yield curve for each AU. Yield tables are included in Appendix 5.

11.8 Existing timber volume check

To verify that no errors were made in aggregation and that no significant aggregation bias exists, the total volume of the current (starting) inventory using polygon-specific inventory volumes has been compared to the total volume of the current inventory based on analysis unit volumes. The results for existing natural (VDYP) AU's are shown in Table 51. There is poor correlation between the AU values and the inventory values for the partially cut AU's and problem forest type (PFT) AU's. Partially cut AU volumes (101,102,150-153) only reflect the volume available for harvest (subset of stand volume) and the PFT AU's (102, 113,152,153) have undergone a 55% volume reduction. TIPSY AU's are not shown here because volume comparisons with VDYP have little value. Overall, the volumes being generated from the AU yield tables correlate well with the inventory (<1% difference).

Table 51. Existing timber volume check

AU	THLB Area (ha)	Volume derived from:		Difference		Comments
		Inventory	Yield tables (AU)*	m^3	%	
101	1,782	194,951	218,810	23,859	12%	AU yields only represent volume available for harvest.
102	90	4,471	3,867	-604	-14%	
103	7,193	885,772	887,729	1,957	0%	AU 113 is low because it is a problem forest type
104	16,088	2,127,891	2,194,498	66,607	3%	
105	9,340	1,521,594	1,459,848	-61,746	-4%	
106	19,048	3,157,168	3,143,392	-13,777	0%	
107	28,705	2,351,194	2,281,546	-69,648	-3%	
108	12,618	2,194,012	2,130,221	-63,791	-3%	
109	1,662	248,413	292,218	43,805	18%	
110	7,125	1,077,796	1,055,545	-22,250	-2%	
111	55,701	8,996,615	9,207,258	210,643	2%	
112	62,974	12,939,642	13,252,067	312,425	2%	
113	17,734	2,142,356	995,136	-1,147,220	-54%	
114	1,386	280,780	286,785	6,005	2%	
115	8,143	1,427,897	1,473,785	45,888	3%	
116	6,603	1,384,604	1,418,389	33,785	2%	
117	4,807	672,051	689,642	17,591	3%	
118	18,225	2,708,234	2,666,434	-41,800	-2%	
119	21,507	3,242,632	3,161,661	-80,970	-2%	
150	18,593	1,548,264	1,209,127	-339,137	-22%	AU yields only represent volume available for harvest. PFT AU's have a 55% volume reduction.
151	41,113	3,796,548	2,376,148	-1,420,399	-37%	
152	790	45,201	18,968	-26,233	-58%	
153	979	62,672	17,153	-45,519	-73%	
All VDYP	**362,206**	**53,010,759**	**50,440,228**	**-2,570,531**	**-4.8%**	87% of the THLB.
VDYP - no PC or PFT	**281,124**	**45,216,296**	**45,601,018**	**384,721**	**0.9%**	**AU yields are higher than inventory volumes by <1%**

* Actual yields used in the model are lower because of reductions for WTP's, Identified Wildlife, and historical partial cutting adjustments. The volumes reported here are meant to be consistent with the inventory volumes reported for each polygon.

12.0 Silviculture

12.1 Silviculture management regimes

After harvest, stands in the TSA follow various silvicultural management regimes depending on originating stand type. Some stand types rely on natural regeneration while others rely on planting or a combination of the two. This section of the data package summarizes the silvicultural management inputs used in the TIPSY growth and yield model for each managed stand AU. Current practices are reflected in the Future Managed Stand AU's (200 series) found in Table 52, while historical regeneration practices are reflected in the Existing Managed Stand AU's (500 series). When existing managed stands are harvested, they move onto an additional set of future managed stand AU's (600 series) that are identical to the 500 series but reflect the genetic gains for future managed stands.

Table 52. Regeneration Assumptions

Analysis Unit #	Regeneration Method and Weighting (%)	Regenerating Species and Weighting (%)	SI	Initial Density (stems/ha)	Regeneration Delay (years)	Comments
Future Managed Stands						
201	Natural 100%	$Fd_{85}Py_{10}Lw_5$	15.8	N/A	N/A	Modeled as a shelterwood-like system with an overstory removal after 10 years and natural regeneration.
203	Natural 5% Planted 95%	$Fd_{40}Pl_{30}Lw_{20}Sx_{10}$ $Fd_{50}Pl_{20}Lw_{20}Sx_{10}$	12.2	2200 1600	1 1	Advanced regeneration is partially kept. Fill planted with a variety of species.
204			15.3			
205			19.8			
206	Natural 5% Planted 95%	$Sx_{40}Bl_{40}Pl_{10}Cw_5Hw_5$ $Sx_{45}Pl_{40}Bl_{10}Lw_5$	11.2	1800 1400	1 1	Sx/Bl stands.
207			15.2			
208			20.4			
209	Planted 100%	$Sx_{50}Lw_{40}Cw_5Pl_5$	15.0	2200	1	Cw/Hw stands
210	Natural 10% Planted 90%	$Pl_{50}Lw_{25}Fd_{15}Sx_5Bl_5$ $Pl_{50}\ Sx_{25}Lw_{20}Bl_5$	12.0	2200 1600	1 1	Pine ground based harvest has more disturbance and more natural regeneration.
211			15.9			
212			19.7			
213			14.1			
214	Natural 5% Planted 95%	$Pl_{30}Lw_{25}\ Bl_{25}Fd_{10}Sx_{10}$ $Pl_{50}\ Sx_{35}Lw_{10}Bl_5$	12.7	2000 1600	1 1	Pine cable harvest has less disturbance and less natural regeneration.
215			15.7			
216			19.4			
217	Natural 5% Planted 95%	$Lw_{30}Pl_{25}\ Fd_{25}Sx_{10}Bl_{10}$ $Lw_{60}Pl_{20}\ Sx_{10}Fd_5Bl_5$	12.0	1400 1200	1 1	
218			15.7			
219			19.7			
251	Natural 100%	$Fd_{85}Py_{10}Lw_5$	13.8	N/A	N/A	FMER Open Forest – modeled as uneven age stand with periodic volume removals.
Existing Managed Stands						
501	Natural 100%	$Fd_{85}Py_{10}Lw_5$	17.2	N/A	N/A	FdPy, Py AU's
502	Planted 100%	$Pl_{53}Fd_{35}Lw_{10}Sx_2$	15.7	2200	3	FdOthers AU's
503	Natural 35% Planted 65%	$Pl_{79}Lw_{21}$ $Pl_{69}Sx_{25}Lw_5Bl_1$	15.1	2400 1600	2 3	SxBl AU's
504	Planted 100%	$Lw_{59}Pl_{33}Sx_8$	16.6	2200	3	CwHw AU's
505	Natural 30% Planted 70%	$Pl_{68}Bl_{10}Lw_{10}Fd_{10}Sx_2$ $Pl_{82}Sx_8Lw_8Fd_1Bl_1$	16.5	2800 1800	2 3	Pl – Slopes 0-40% AU's
506	Natural 25% Planted 75%	$Pl_{68}Bl_{10}Lw_{10}Fd_{10}Sx_2$ $Pl_{82}Sx_8Lw_8Fd_1Bl_1$	16.6	2800 1800	2 3	Pl – Slopes >40% AU's
507	Natural 20% Planted 80%	$Pl_{76}Fd_{24}$ $Pl_{60}Lw_{33}Sx_4Fd_2Bl_1$	16.8	1400 1200	2 3	Larch was generally not planted before 1995.

In general, existing managed stands are modeled with longer regeneration delays, higher reliance on natural regeneration, and less planted Lw than the future managed stands. This reflects the range of practices that have occurred from 1982 to present[50]. Future managed stand inputs are more optimistic because current day practice is to aggressively restock areas through timely planting and utilization of superior genetic stock (i.e. Sx, Lw).

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[50] The natural/planted percentages, stocking densities, and species distributions are based on data summarized out of ISIS (SIA) from 1982 to 2002.

The initial stocking densities shown in Table 52 represent the density of the stand layer that will form the next crop. The intent was to identify the density of future crop trees that are competing for light, space and nutrients at the time of free growing declaration – all other stem layers were not considered because they are not relevant in the growth model. These densities were estimated after reviewing ISIS total stocking & well-spaced densities and conducting discussions with government and licensee silviculture staff about local regeneration dynamics. The final density numbers were lower than what MoF district staff suggested and higher than what licensees were suggesting.

Another factor considered during the development of the initial stocking densities was the fact that densities are likely to fall as stands move out of the plantation stage because there is often some level of mortality related to plantation forest health issues (root rot, rust, weevils, etc). The additional density on these sites may act as a safety net ensuring that plantations maintain critical minimum stocking levels. TIPSY does not remove stems for forest health reasons (it only alters volumes) so it was important that initial densities provided to the model reflect the number of healthy competitive stems in the future crop layer.

12.2 Regeneration delay

Regeneration delay is the time elapsed between harvesting and the time when stand growth begins. The delay incorporates both the time taken to establish a stand, and the age of seedling stock planted, if applicable. For this analysis, regeneration delay was addressed separately for existing managed stands and the future managed stands.

Existing Managed Stands:

For existing managed stands, regeneration delay was addressed through the use of actual stand age in the forest inventory file. This age represents the actual age of the stand and not the time since harvesting. For example, a stand may have been harvested 15 years ago but the current stand age is 12 – this implies a 3 year regeneration delay). The use of actual ages eliminates the need to estimate an average regeneration delay for these stands.

Future managed Stands:

For planted sites, current practice in the Cranbrook TSA is to plant the year following harvest with one year old stock (i.e. no regeneration delay). There are some sites that are not restocked this quickly due to plantation failures, seedling delays, or general logistics. Because of this small amount of area, the actual regeneration delay is somewhere between 0 and 1 year. For the purpose of this analysis, a one year regeneration delay was used for future planted stands. Statistics gathered from ISIS[51] support this logic since the average regeneration delay for planted stands over the last 6 years is less than 0 – indicating the presence of acceptable advanced generation on many sites.

Current practice also utilizes natural regeneration on a small amount of sites where it is well advanced and in good condition. In these cases the regeneration delay is often non-existent because many stands are already stocked after harvest. A regeneration delay of one year was used for naturally regenerated future managed stands outside of the Open Forest (151,153) or FdPy Shelterwood (101,102) AUs.

Non Open Forest and Non FDPY Sheterwood AU's:

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[51] To determine regeneration delay, the Silviculture Information Access database was queried for stands harvested, regenerated and satisfactorily restocked since Jan. 1, 1996, (approximating introduction of the Forest Practices Code). Silviculture surveys conducted during this time would have been done in accordance with the Silviculture Surveys Guidebook. The guidebook outlines procedures for stocking surveys including discerning acceptable advanced regeneration, entering multistoried stand information, and describing the silviculture layer. The silviculture layer is to be composed of only acceptable and preferred well-spaced trees. To assign the appropriate regeneration delay to each analysis unit, the data was queried using the leading previous stand species, and the distribution of resulting silviculture layer species was noted. The average age of all silviculture layers (in the case of multistoried stands) was extracted in the query. Multi-storied silviculture layers are to be noted only where they have over 6% crown closure according to the guidebook. Layers with less than or equal to 6% crown closure are classed as veteran and are not are not included in this average. Regeneration delay was then calculated by subtracting the disturbance date from the reference year less average age of all silviculture layers.

Statistics gathered from ISIS support this logic because the average regeneration delay for these stands is at least –15 yrs in all AU's. This does not infer that all future crop trees are on site when harvesting takes place but does assume that there are many sites that are well advanced after harvest (negative regeneration delay) and some that take longer to come on line (positive regeneration delay). On balance, the regeneration delay for these sites is well below zero. To be conservative, the analysis utilizes a regeneration delay of 1 year for naturally regenerated stands.

Open Forest and FdPy Shelterwood AU's:

These AU's use a 10 year regeneration delay because of the challenges in regenerating Douglas-fir on these sites (cattle, elk, ecological extremes) and the forest health issues associated with establishing pine on these sites.

These regeneration delays are different from TSR2 (2yr natural, 3yr planted) for several reasons. TSR2 grouped existing and future managed stand together and therefore had to consider historical regeneration practices in the TSA when setting regeneration delays. Historical practices relied more heavily on natural regeneration and were generally more passive in their planting practices. Thus, average regeneration delays applied to the entire block of managed stands in TSR2 were higher than TSR3. In addition, planting is pursued more aggressively now relative to TSR2. Licensees routinely order stock prior to harvesting to minimize any delays and are planting more sites/species in order to reduce green-up time and capitalize on the genetic gains associated with 'A' class seedlings.

Regeneration delays for future managed stands were incorporated into FSSIM through assignment of negative ages after harvesting. Yield curves do not include a regeneration delay. For example, after a stand is harvested it is assigned an age of -1 in order to reflect a 1 year regeneration delay. This results in the stand waiting one year before starting to grow on the yield curves utilized in the model.

12.3 Stand rehabilitation

No stand rehabilitation is currently occurring in the TSA. No rehabilitation was modeled.

12.4 Gene resources — use of select seed

As required by the Forest Practices Code, the TSA uses the best genetic quality seed and vegetative material available for regeneration. This section describes the yield adjustments to account for the use of select seed (i.e., orchard & select provenance seed with a known genetic gain as measured by Genetic Worth [GW]). Seed planning units (SPU's) are used to track the genetic worth and use of different seedlots. The select seed SPU's that occur within the Cranbrook TSA are as follows:

Table 53. Seed Planning Units within the Cranbrook TSA (Class A Seed).

SPU	Gross Area within TSA (ha)	Min Elev. (m)	Max Elev. (m)	**Class A Seedlings Requested in 2003**	**Actual Genetic Worth % Achieved in 2003***	**Projected Future Genetic Worth % (2013)**
FD EK ALL	484,868	1	1500	0		0%
FD NE HIGH	61,297	1000	1500	0		22%
FD NE LOW	313	1	1000	0		0%
LW EK ALL	235,128	800	1500	1,339,000	12%	14%
LW NEK HIGH	37,484	1300	1500	0		14%
LW NEK LOW	32,060	800	1300	0		18%
PLI EK HIGH	369,687	1500	2000		0%	0%
PLI EK LOW	159,233	1	1500	956,900	3%**	12%
PLI NE HIGH	293,323	1400	2000			0%
PLI NE LOW	24,063	1	1400	39,300	6%	14%
SX EK ALL	439,711	1	1700	553,500	23%	26%
SX NEK HIGH	37,607	1500	1700	118,600	7%	7%
SX NEK LOW	5,934	1	1000	0		7%
SX NEK MID	87,858	1000	1500	128,200	9%	8%

* Values obtained from SeedMap report titled "Genetic Gain: Report 1 – Genetic Worth of Seedlings Requested by Species and SPZ" and filtered to the Cranbrook TSA.

** Pl GW of 3% is from B+ seed available to the TSA (Rocky Mtn Trench – Cartwright) for sites under 1475m.

Historical use of select seed was obtained from the Ministry of Forests Seed Planning & Registry system (SPAR) – SeedMap summary reports. This information was used to derive net genetic gain estimates (Net GW) at the species level (Table 54) for use during modeling of existing and future managed stand yields. Table 54 illustrates the weighted average GW for each species for the last six years [A], the percent select seed use for each species in the TSA [B], and the Net GW for each species [C]. The Net GW is calculated by multiplying [A] x [B] and is graphed in Figure 52.

Table 54. Calculation of net genetic worth by species in the Cranbrook TSA.

	Wt Avg* GW by Species (Class A) [A]				% Class A of Total Seedlings Planted [B]				Net GW by Species [C]			
Year	Fd	Lw	Pl	Sx	Fd	Lw	Pl	Sx	Fd	Lw	Pl	Sx
1998			3%	5%			35%	40%		0%	1%	2%
1999			3%	12%			35%	47%		0%	1%	6%
2000		3%	3%	11%		58%	35%	71%		2%	1%	8%
2001		3%	3%	12%		57%	35%	55%		2%	1%	7%
2002		3%	3%	16%		75%	35%	75%		2%	1%	12%
2003		7%	3%	18%		87%	35%	93%		6%	1%	17%
5 yr Avg		4%	3%	12%		69%	35%	64%		2%	1%	8%
20 yr Avg		1%	1%	4%		14%	11%	19%		**1%**	**0%**	**3%**

* Weighted average is based on the amount of seed requested from each class "A" SPU occurring in the TSA and its genetic worth (SeedMap Genetic Gain: Report 1 – Genetic Gain of Seedlings Requested by Species and SPZ). The Pl GW is based on B+ seedlots.

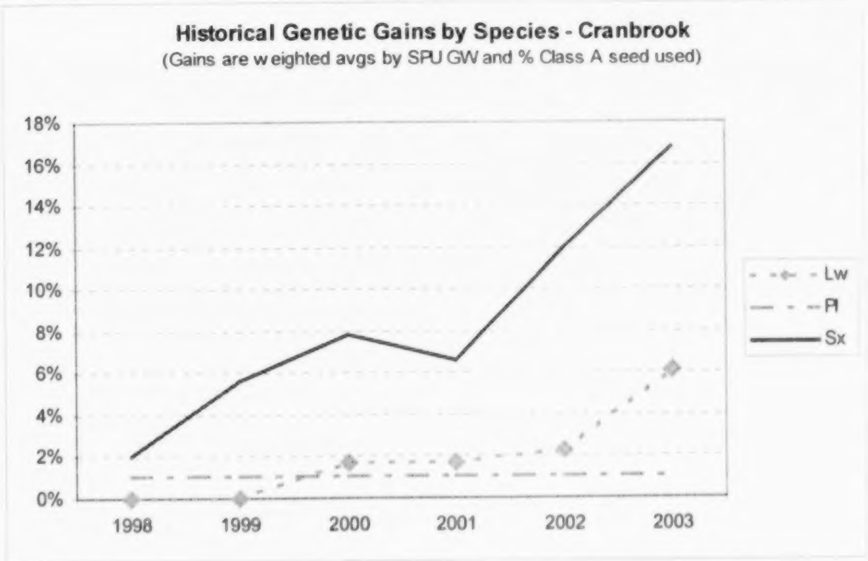

Figure 52. Net Genetic Worth for All Seedlings by Species - Cranbrook TSA

The application of this data in the timber supply model is summarized in Table 55 and described below.

Table 55. Net genetic worth by species to be applied in timber supply model

Time Horizon in Model (decades)	**Species**	**Genetic Gains applied in TIPSY For Base Case**		**Genetic Gains applied in TIPSY for Sensitivity Analysis**	
		Existing Managed Stands	Future Managed Stands	Existing Managed Stands	Future Managed Stands
1-25	Fd	-	-	-	5
1-25	Lw	1%	6%	1%	14
1-25	Pl	-	1%	-	2
1-25	Sx	3%	17%	3%	19

In the Base Case, the 20 year historical averages from Table 54 were applied when modeling existing managed stands because this best corresponds with the criteria used to define these stands. When generating the AU yields in TIPSY for these stands, larch has a 1% GW applied while spruce has a 3% GW applied. These values are lower than those applied to future managed stands because the GW realized on present day stock is watered down by historical use of stock with no genetic gain. Future managed stands have the 2003 Net GW's for Sx (17%), Pl (1%), and Lw (6%) used in the Base Case. Again, the GW's were applied in TIPSY when generating AU yields for these stands.

No adjustment of genetic gains was anticipated during the planning horizon.

A sensitivity analysis was performed to explore the implication of applying forecast 2013 GW's based on projected orchard gains and projected seed availability (orchard production) for Sx, Pl, Lw, and Fd. The projected Net GW for each species was based on the values shown in Table 53 (prorated by THLB area) and considered select seed availability as projected in the SPU timelines provided by Tree Improvement Branch. Genetic gains associated with existing managed stands were unchanged in the sensitivity analysis.

Genetic gains were incorporated into the growth and yield curves through TIPSY model functionality. Whenever a species identified in Table 55 is included in a managed stand AU, its associated Net GW was input into TIPSY. This Net GW reflects the genetic gain associated with all seedlings of a given species planted in a typical year. Where surrogate species were used in TIPSY, the GW was prorated to reflect the relative GW's of the original species (Sx used for Bl but Sx GW was not applied to Bl proportion).

12.5 Silviculture history (defining existing managed stands)

As discussed in the Analysis Units section above, existing managed stands were defined as those stands regenerated from 1982 forward (currently <=20 yrs old) plus any older stands with a record of planting or spacing in the forest inventory file. The 1982 date corresponds with the time period where silvicultural management regimes were regularly utilized in the TSA (legal obligations to reforest) or management regimes were applied to clean up earlier harvesting (Industry outstanding stands were addressed).
Through funding sources such as FRDA (1&2), FRBC, and FIA, the vast majority of the older plantations in the TSA have been assessed. These plantations either had adequate stocking, had treatments applied to increase stocking above minimums, or had a rationale that even with stocking below minimums, a commercial crop would be established. Large areas were spaced in the early 1990's.
Both future managed stands and existing managed stands were modeled using TIPSY utilizing the inputs shown in Table 45 and Table 46 respectively. The initial densities shown in these tables reflect the poor economic realities of spacing now and into the foreseeable future. Spacing treatments are being carried out only to avoid repression and there is little attempt made to manage densities to target stocking levels. In recognition of this, higher densities than target stocking were modeled in TIPSY for many AU's.

12.6 Backlog and current not satisfactorily restocked areas (NSR)

Backlog NSR is any area that was denuded prior to 1987 (when basic silviculture became the obligation of licensees) and is not yet fully stocked. All other NSR areas are considered current NSR. Current NSR is assigned to existing managed stand analysis units and any delay in restocking these sites is reflected in the regeneration delay's assigned to these analysis units. These sites have either been reforested but are not yet confirmed in the inventory file, or will be reforested because licenses are under a legal obligation to do so.

Backlog NSR was discussed with District silviculture and planning staff. Based on reviews done by District staff following TSR2, most of the NSR on record at that time was reclassified due to non-crown ownership, Open Range, inoperability, or other factors. The current estimate of Backlog NSR from district silvicultural data (ISIS / SIA) is 1381 ha. District staff indicated that about half of this area should be maintained in the working land base, while the other half should be removed because of factors that make it infeasible to restock these areas (shallow soils, extensive exposed rock or talus, excessive debris, inaccessible, too small to treat, too expensive to treat, etc). To spatially identify areas that would be removed from the timber harvesting land base, backlog NSR openings numbers were extracted from ISIS/SIA and the following areas were selected for removal: old burns and any areas classed as non-plantable. These sites represented 648.5 ha or roughly half of the total backlog NSR area.

The area of backlog NSR that was to remain in the working land base (732.5 ha) was assigned an age of zero and incorporated into the appropriate existing natural stand analysis units with a 40% volume reduction (based on professional judgement). These sites currently have partial stocking, and are expected to gradually fill-in. This lag time to attain minimum stocking levels was partially offset by the discounting of the advanced stocking on these sites, but lower volumes are still expected.

Table 56. Backlog and Current NSR

NSR Type	Area to Remain in THLB	Netdown Area (Non THLB)	Total NSR in ISIS (ha)
Current NSR	14790	0	14,790
Backlog NSR	732	525	1,381
Totals	15522	525	16,171

The current NSR noted above, along with areas of backlog NSR expected to be restocked, were also subject to netdowns for riparian, steep ground, low site index and other netdown factors which were applied to the TSA.

13.0 Unsalvaged Losses

The purpose of this section is to quantify the average annual volume of timber that, in the future, will be damaged or killed on the THLB and not salvaged or accounted for by other factors. These losses are due to a number of factors that cause tree mortality, including insects, disease, blowdown, snowpress, wildfires, etc. This factor is meant to capture catastrophic natural events like the fires that occurred in the Cranbrook TSA in 2003. Endemic pest losses are dealt with through factors applied in the growth and yield models as noted below:

TIPSY: Operational Adjustment Factors reduces gross volumes to account for losses toward maturity such as decay, and endemic forest health issues like minor infestations.

VDYP: The model predicts actual average yields from appropriate inventory ground plots. Endemic losses are inherently recognized in the model data.

The annual unsalvaged losses determined in TSR2 are still considered valid and will also be used in this analysis. Although the Ministry of Forests is currently reviewing these numbers in consideration of the 2003 fires, they were not available for incorporation in this analysis.

Table 57. Unsalvaged losses

Description	Annual unsalvaged volume in the THLB (m^3/year)
Mountain pine beetle	43,561
Douglas-fir bark beetle	251
Balsam bark beetle	337
Blowdown / snowpress (mature stands)	11,748
Non catastrophic in-block blowdown/snowpress	4,048
Non catastrophic blowdown/snowpress (cutblock edges)	3863
Non catastrophic blowdown/snowpress (right of way edges)	5,569
Oil, gas, and mineral exploration	50
Coal Mine Spoil Failures	50
Wildlifes	7,384
Red-belt damage	350
Total	77,241 m^3

The losses shown above are based on merchantable volume losses. Losses associated with immature stands also impact the rate at which timber becomes available in the TSA but little data is available to estimate the extent or impact of these losses. These disturbances will be captured during periodic inventory updates and are therefore reflected in subsequent TSR's. Refer to section 13.1 for information on how the 2003 fires were handled in the analysis.

Unsalvaged losses were implemented in FSSIM by adding 77,241 m3/yr to the desired harvest requested for each decade, and then subtracting the 77,241 m3/yr from the forecast for reporting. This resulted in an estimate of timber supply available for human use and ensured that natural disturbances are being modeled inside the working land base. Natural disturbance outside of the working land base is addressed in Section 14.5.1.1.

13.1 Treatment of 2003 Fires

The fires of 2003 impacted considerable area in the Cranbrook TSA and resulted in a large-scale salvage effort. Table 58 and Figure 53 below provide details on the area and volume impacted. Within the THLB, a total of 11,313 ha were included in the mapped fire boundaries.

Table 58. 2003 Fire Area and Volume Summary[52]

	Forest District		THLB	
FIRE	Area (ha)	Coniferous m3	Area (ha)	Coniferous m3
Calamity Creek	624	39,924	41	-
Crossing Creek	43	1,290	2	366
Cummings Creek	895	91,030	13	3,891
Lamb Creek	12185	1,236,072	7164	792,819
Middle Fork/White River	120	6,291	0	0
Plumbob Mountain	3507	338,659	2554	280,773
Rainbow Creek	73	12,223	0	-
Ram Pass	4987	378,590	1539	22,250
Fire Totals	**22,434**	**2,104,079**	**11,313**	**1,100,099**

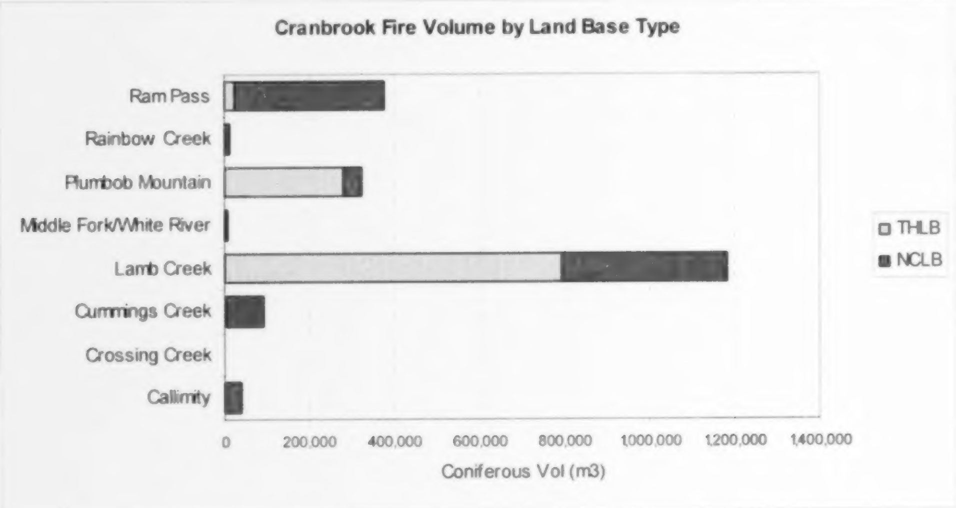

Figure 53. 2003 Fire Volume by Land Base Type

For modeling purposes, the following was applied in the Base Case:

- The burnt areas within the fire boundaries were assigned to a set of AU's (9000 series) that mimic the standard AU's but allowed the application of volume reductions in FSSIM. The size of this reduction (30%) was determined based on licensee salvage efforts to date (CP's cruised before the fire were used to compare before and after volumes). Licensees also have suggested that approximately 10% of the fire areas remains as green timber – however this has not been captured in the model.
- Fires salvage areas were assigned the highest harvest priority. Any areas harvested in the model were given a 2 year regen delay and assigned to standard managed stand AU's. The amount of salvage harvesting allowed to occur in the first 2 years of the planning horizon was limited to the volume expected to be salvaged by licensees (394,800 m3). This was calculated by reducing the volume proposed by licensse planners 564,000 by 30%.
- All fire salvaged stands were assumed to regenerate to managed stand yields.

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[52] At the time the datasets were assembled to create this data package (October 2003) – no data was available for the Sulphur Creek or Shepp Creek fires.

- After two years, any burnt stands that were not salvaged were assumed to regenerate naturally. These stands were transferred to standard natural stand AU's with an age of –2 (four-year regen delay).
- In order to recognize that the fire will have created new non-productive areas, the productive area within the fire was reduced by 10% in the timber supply model.
- All forest cover constraints were removed from the fire areas during salvage operations (first 2 years).

14.0 Integrated Resource Management

The range of timber and non-timber resource management zones that occur within the TSA were briefly outlined in Section 10.1 of this document. This section of the document describes the forest cover requirements that are associated with these resource management zones.

Forest cover requirements are typically expressed as:

- a maximum amount of forest that can be younger than age X (or shorter than height Y);
- a minimum amount of forest that must be older than age W (or taller than height Z);

As discussed previously, these forest cover requirements can be overlapping within the TSA. The FSSIM model evaluated each requirement independently to ensure that the harvesting of a specific area was not violating any forest requirements.

14.1 Green-up/adjacency

The HLPO specifies different green-up requirements to be applied within the Cranbrook TSA. These requirements specify that a logged block must achieve a specific condition called green-up before adjacent areas can be logged. Green-up refers to the height of the regenerating forest reaching a specified target. Green-up requirements can often be waived if licensees manage for patch size distributions specified in the HLPO and detailed in the Landscape Unit Planning Guide (MoF/MoE 1999). Modeling of green-up requirements was done using forest level objectives, as opposed to block specific objectives, because this was consistent with the operational flexibility afforded by patch size management. Green-up requirements and how they were modeled are provided in Table 59.

Table 59. Green-up requirements by management zone

Management Zone	Green-up Requirement	Modeled Green-up Constraint	Area to which it applies
ERDZ Timber Zone	Successful regeneration (stocked)	Max 33% < 2 yrs	THLB area inside the HLPO mapped ERDZ timber zone. In ERDZ, the 'greenup' requirement is only that stands be 'stocked', therefore a greenup of 2yrs applied..
Fire Maintained Ecosystems – Open Range and Open Forest	None	None	Open Range and Open Forest areas (FMER mapping)
Integrated Resource Management Zone	2.5 m tall trees	Max 33% < 12 yrs	THLB area not included in the above 2 zones – by LU.

Using Site Tools 3.2m, age to green-up was determined using a weighted average stand type and site index for the IRM zone. Based on an analysis of leading species and average characteristics for the IRM zone, a 2.5m height can be achieved in 12 yrs (Pl stand with SI of 16.6, plus a 1 year regen).

14.2 Visual resources

The District Manger of the Rocky Mountain Forest District established new Visual Quality Objectives (VQO's) with a letter to licensees on March 14, 2003 that also required consideration of Front Country Visual Management Guidelines outline in KBLUP-IS (sec 3.8). Forest cover requirements aimed at meeting these objectives was applied so that the amount of younger stands that can occur in visually sensitive areas is limited.

The following procedure were used to model visual quality objectives:

1. All VQO polygons within Fd/Py Selection, Open Forest and Open Range AU's were anticipated to meet VQO's through partial cutting regimes and good visual design. Harvesting in these stands did not impact the percent disturbance limits for VQO's because stand age was always be older than the green up age.

2. VQO polygons where partial cutting regimes are not dominant (ie, clearcut with reserves, seed trees, etc) have maximum planimetric percent disturbance values assigned based on VQO, visual absorption capability, and viewing distance from main corridors/towns (values provided in Table 60). The viewpoints/corridors used were defined in the KBLUP-IS (Front Country Visual Management Guidelines).

Table 60. Visually sensitive areas: Maximum planimetric disturbance %'s

VQO	<1 km View Distance			1-5 km View Distance			5-12 km View Distance			>12 km
	Low VAC*	Mod VAC	High VAC	Low VAC	Mod VAC	High VAC	Low VAC	Mod VAC	High VAC	All VAC's
Preservation	0%	1%	2%	1%	2%	3%	2%	3%	5%	5%
Retention	3%	5%	7.5%	5%	7.5%	10%	7.5%	10%	15%	15%
Partial Retention	10%	12.5%	15%	12.5%	15%	17.5%	15%	20%	25%	25%
Modification	15%	17.5%	20%	17.5%	20%	22.5%	20%	25%	33%	33%

* VAC = Visual absorption capability

3. VQO polygons each had an area weighted average slope assigned and a "visually effective green-up" (VEG) height calculated according to Table 61 extracted from *Procedures for Factoring Visual Resources into Timber Supply Analyses (MoF 1998)*.

Table 61. Tree heights required for meeting visually effective green-up by percent slope.

	Slope Class %'s											
	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-45	46-50	51-55	56-60	60+
Tree Height (m)	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.3	8.5

4. Each VQO polygon had the resulting forest cover objective applied to its crown forested area in the model. For example, a VQO of Retention in the foreground with a VAC of High and an average slope of 32% had the following objective: No more than 7.5% of the crown forested area in the VQO polygon can be under 6m tall.

The maximum disturbance percentages outlined in Table 60 were developed for use in the East Kootenay's by MoF District and Regional staff[53]. They were believed to reflect current management in the TSA and reflect the use of good visual design during the development of cutting permits.

The visually effective green-up heights determined for each polygon were translated into green-up ages for use during modeling. Age to green-up was calculated in SiteTools using a weighted average leading species and site index based on all VQO polygons. Visually effective green-up ages ranged from 13 to 28 years and was based on a Pl stand with an site index of 15.9.

14.3 Recreation resources

Forest cover retention within important recreation areas in the TSA were addressed through the netdown process and the application of forest cover retention for other values. Riparian reserves and recreation areas (UREPs) identified in the ownership file as under 100 ha were completely removed from the working land base. Those over 100 ha were not removed unless some other netdown factor removed them. On balance this removed a representative area that would not be eligible for logging (i.e. Forest Service recreation sites).

In addition, visually sensitive areas, riparian zones, caribou / UWR habitat areas, community/domestic watersheds, and lakeshore management zones on lakes over 5ha tend to overlap important recreation areas. The forest cover requirements on these zones help to accommodate recreational values. Thus, recreation resources did not have any specific additional forest cover objectives applied because other existing objectives were seen to adequately reflect current management for recreational values.

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[53] Mike Black, MoF Rocky Mountain Forest District and Peter Rennie, MoF Southern Interior Forest Region, Oct 2003.

14.4 Wildlife

14.4.1 Ungulate winter range

Two sources of UWR data currently exist:

KBLUP-Implementation Strategy UWR: This UWR strategy was "made known" in 1998 and the most recent District Manager instructions for preparation of FDP's references this version of UWR. The current interpretations of its management objectives are listed below.

Table 62. KBLUP-IS UWR forest cover requirements

Snow Depth	Species	Forest cover objective*	Area of Application	Comments
Deep Snow Zone (defined as BEC zones other than PP or IDF)	Moose	Min 50% >120 yrs	Crown forested area within each LU. Not FMER Open Range or Open Forest areas.**	The most limiting forest cover requirement was applied to polygons with multiple species listed.
	Whitetail	Min 40% > 100 yrs		
	Mule	Min 35% > 100 yrs		
	Elk	Min 30% > 100 yrs		
Shallow Snow Zone (defined as PP or IDF BEC zones - ICH xm does not exist in Cranbrook)	Whitetail	Min 30% > 100 yrs		
	Elk	Min 25% > 100 yrs		
	Mule	Min 25% > 100 yrs		
	Moose	Min 40% > 81 yrs		

* As consolidated by Al Neal Oct 9, 2003.

* * Open Range and Open Forest areas identified in the Fire Maintained Ecosystem Restoration mapping had no cover requirements applied since the objective in these areas is to produce forage habitat..

PEM Based UWR: After TSR 2, a committee was stuck to examine UWR management practices in the East Kootenay. The committee has developed an ecosystem based management strategy for UWR management with objectives for both landscape and stand level management. The committee's UWR mapping is based on capability ranking derived from a coarse Predictive Ecosystem Map (PEM). Management objectives are provided for various ecosystem types (i.e. Open Forest, Open Range, and managed forest units defined by moisture regimes).

Table 63. PEM Based UWR forest cover requirements

Habitat Type	Forest cover objectives*	Area of Application	Comments
Open Range	None	Crown forested area within each LU by habitat type.	Habitat zones were derived from the EK PEM.
Open Forest	None		
MF-Dry	10% > 100yrs		
Managed Forest -Transitional	20% >= 60yrs, of which 10% >= 100yrs 10% < 31 yrs		
Managed Forest -Mesic	30% >= 60yrs of which 20% >= 100yrs 10% < 31 yrs		
Managed Forest -Moist	20% >= 60yrs 10% < 31 yrs		
Managed Forest -Wet	30% >= 60yrs 10% < 31 yrs		

Application in the Base Case:
With the official release of the Southern Rocky Mountain Management Plan (SRMMP) on August 28, 2003, the new PEM based UWR became policy within the SRMMP area. Thus within the SRMMP area, the Base Case will use the PEM based UWR and outside of the SRMMP area, the KBLUP-IS UWR was used.
A sensitivity analysis was performed to assess the impacts of applying the new PEM based UWR throughout the TSA (Section 6.7).

14.4.2 Identified wildlife

The following species occur within the Cranbrook Forest District and have been classified as "Identified Wildlife" by the Identified Wildlife Guidebook (MoF 1999).

Bull trout
Tailed frog
Rubber boa

Fisher
Grizzly bear
Mountain goat
Bighorn sheep

American bittern
Northern goshawk
Prairie falcon
Sandhill crane
Long-billed curlew
Lewis woodpecker
Grasshopper sparrow
Bobolink

A legal Wildlife Habitat Area (WHA) has been established for Lewis woodpecker in the Cranbrook TSA, and WHAs were in development for Bull Trout and Tailed frog. The WHA's for Lewis woodpecker and bull trout were not expected to have any impacts on timber supply and the impacts of the proposed Tailed frog WHA were uncertain at the time of analysis[54]. The impacts of future WHA's was budgeted at a 1% AAC impact by provincial policy. This 1% was not implemented in the model in order to allow the Chief Forester to consider this issue in his determination (refer to section 9.4.9 for more detail).

14.4.3 Caribou

Section 3 of the Kootenay Boundary Higher Level Plan Order specifies caribou habitat management guidelines to be applied in a number of zones within mapped caribou habitat. The forest cover requirements associated with these zones can be found in Table 64 and was modeled in the Base Case.

Table 64. HLPO caribou forest cover requirements

BEC/ Caribou Zone	Forest cover objectives	Area of Application	Comments
Subalpine parkland	No harvesting allowed	Crown forested area <80% slope within each habitat type by LU – less any areas of parks, protected areas, ecological reserves, or alpine forest.	Only Priority 1 and 2 mapped caribou polygons were utilized.
ESSF above Caribou line	70% > 140yrs		
ESSF below Caribou line	40%[55] >140 with 10% >250yrs		
ICH above Caribou line	70% > 140 yrs		
ICH below Caribou line	40% > 140 with 10% > 250yrs		
MS	40% > 100		

New caribou guidelines based on habitat types were recently finalized and should soon become legal through an amendment to the Higher Level Plan Order. These guidelines can be found in Table 65 and were modeled in a sensitivity analysis utilizing the new caribou line work (Section 6.8).

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[54] Personal communciation: Peter Davidson – WLAP Ecosystem Biologist (Cranbrook). Sept 2003.

[55] Increased to 40% to account for the HLPO requirement that 20% come from partial cut stands.

Table 65. Habitat requirements for the South Purcell caribou herd (Oct 2003)

BEC/ Habitat Zone	Forest cover objectives	Area of Application	Comments
Core – above caribou line	No harvesting allowed	Crown forested area <80% slope within each habitat type by LU – less any areas of parks, protected areas, ecological reserves, or alpine forest.	Pl/Fd/Lw leading stands have no forest cover requirements in Core, Supporting, or Recovery habitat types. No cover requirement was required in movement corridors.
Core – below caribou line within S/B/Pa/La/C/H leading stands.	No harvesting allowed		
Supporting – above caribou line	No harvesting allowed		
Supporting – below caribou line within S/B/Pa/La/C/H leading stands.	Min 70% > 60 yrs* and Min 40% > 140 yrs		
Recovery – above caribou line	No harvesting allowed		
Recovery – below caribou line within S/B/Pa/La/C/H leading stands.	Min 70% > 60 yrs* and Min 40% > 140 yrs		
Intra-population Connectivity (All)	Min 33% >= 80 yrs		

14.4.4 Grizzly bear

Section 5 of the HLPO identified important grizzly bear habitat (avalanche tracks, denning sites, etc.) as high priority areas when allocating old and mature forest retention targets (discussed in Section 14.5.1).
The Southern Rocky Mountain Management Plan spatially identified these habitat features and used them during the spatial allocation of old and mature retention areas. These spatial reserves were modeled throughout the planning horizon and addressed the grizzly bear requirements of the HLPO. This area has some of the most important grizzly bear habitat in the TSA (e.g. Flathead Valley).

The rest of the TSA had limited grizzly habitat mapping and what was available was not in a readily useable form for the TSR process. No explicit recognition of these habitat features was included during the assignment of old and mature retention areas in this portion of the TSA. As the level of retention does not change, the impact on timber supply was not seen to be significant. Detailed planning to formally assign old and mature retention in this area will include consideration of grizzly bear habitat features.

14.5 Biodiversity

The *Landscape Unit Planning Guide* (LUPG), released in March 1999, consolidated policy direction and guidance on biodiversity management. The LUPG recommended that biodiversity be managed at both the landscape and stand levels. The primary mechanism for landscape-level management is retention of old and mature seral forest. Stand-level biodiversity is protected through retention of wildlife trees and wildlife patches. The following sections outline how retention of old and mature forest and wildlife trees/patches was modeled.

14.5.1 Landscape-level biodiversity

Sections 1 and 2 of the Kootenay Boundary Higher Level Plan Order specified the amount of old and mature forest that must be maintained within each BEC variant inside each Landscape Unit (LU). Landscape units were legally established along with Biodiversity Emphasis Option (BEO) assignments that guide the level of old/mature forest to be retained in LU's.

Most of the Cranbrook TSA's 38 LU's had a single BEO assigned within them, but there are seven LU's that utilized BEC variant line work to define BEOs within the LU's (Table 44). As new BEC variant line work was utilized in this analysis, the BEO lines in the Higher Level Plan Order (HLPO) no longer corresponded with BEC variant lines and thus created numerous small zones that were not consistent with the original HLPO logic. For the purposes of this timber supply analysis, the mapped BEO's were altered to follow the original HLPO logic (i.e. each BEC variant will belong to only one BEO per LU). This resulted in 164 LU/BEO/BEC combinations to which landscape level biodiversity objectives were assigned (Appendix 3). In an effort to model seral goals that could be used operationally, zones with less than a 5 ha retention target were grouped into the most similar BEC variant in the LU.

Old forest retention was applied in all LU's as per the BEO designation shown in Table 44 and the percentage requirements outlined in Table 66. Mature forest retention was also applied at the percentages shown in Table 66, but only for the specific BEC variants and LU's described in Table 44. Specific old and mature targets by LU/BEO/BEC areas can be found in Appendix 3.

Because of the new BEC mapping, mature targets specified in the HLPO varied as follows:

- LU C02 - High - ESSFwm: ---> old BEC linework had a small amount of ESSFwm in the LU and was assigned a mature target in the HLPO. The new BEC linework had no ESSFwm because the area was remapped into a very large area of ESSFdm. There was no reasonable size area to replicate the HLPO intentions so the mature goal was not modelled in C02 (no other variants named in HLPO).
- LU C09 - Low - ESSFwm: ---> The ESSF wm in the old BEC linework was designated for mature retention in the HLPO, but it was remapped as ESSFdm under the new BEC linework. The mature target was applied to the ESSFdm area in C09 as it was roughly in the same location. It represents less area than the old ESSFwm area but the area of ICHmk1 increased (also had HLPO mature target).

Table 66. Old and mature forest cover requirements for landscape level biodiversity objectives

BEC Zone	**NDT**	**Mature Age (yrs)**	**Old Age (yrs)**	**MATURE + OLD Seral Requirements**			**OLD Seral Requirements**				
				Low	**Inter**	**High**	**Low* 1st Rot**	**Low* 2nd Rot**	**Low * 3rd Rot**	**Inter**	**High**
ESSF wm/wmu	2	>120	>250	14%	28%	42%	3.0%	6.0%	9%	9%	13%
ESSF dk/dku ESSF dm/dmu	3	>120	>140	14%	23%	34%	4.7%	9.3%	14%	14%	21%
ICH dm ICH mk1	3	>100	>140	14%	23%	34%	4.7%	9.3%	14%	14%	21%
IDF dm2	4	>100	>250	17%	34%	51%	4.3%	8.7%	13%	13%	19%
MS dk	3	>100	>140	14%	26%	39%	4.7%	9.3%	14%	14%	21%
PP dh2	4	>100	>250	17%	34%	51%	4.3%	8.7%	13%	13%	19%

* Old seral requirements in Low BEO areas start out at 1/3 old for first 80 years, 2/3 old for the next 80 years, and full old beyond.

Once the necessary amount of old/mature retention was identified for a given LU/BEO/BEC combination, appropriate stands to meet the target were identified. Section 5 of the HLPO influenced this task by stating that high value grizzly habitat and areas inside the mapped connectivity corridors were to be considered high priority areas for retention. This was very challenging to model with existing tools because timber supply models are generally not able to proactively identify retention areas in each decade – they focus on cutting stands that are eligible and thus allocate retention passively. Passive retention strategies were not able to mimic the priority sequence required by section 5 of the HLPO. The solution for this timber supply analysis was to spatially identify the stands for retention prior to modeling and not allow the model to harvest them for the first 80 years. This ensured that all aspects of the HLPO strategy were addressed. The 80th year in the planning horizon was selected because it corresponds with the transition to higher old seral requirements in low BEO areas, and thus marks a logical point to begin to apply seral requirements. As the SRMMP was now legal, the spatially explicit old and mature retention areas identified by this plan were excluded from harvest throughout the planning horizon. Additional seral requirements were applied in the SRMMP area only to low BEO-old seral zones after 80 years to ensure that the full target was met after 240 years. This modeling approach is summarized below.

Summary of Modeling Approach to be used in the Base Case

Area of TSA	First 80 Years	81-160 Years in Future	161-250 yrs into future.
Southern Rocky Mountain Mgmt Plan (LU's 14-18, 23-27)	Prevent harvest of SRMMP Old and Mature retention areas.	Prevent harvest of SRMMP Old and Mature retention areas. Apply 2/3 old seral requirement to Low BEO areas.	Prevent harvest of SRMMP Old and Mature retention areas. Increase requirement on Low BEO area to full target.
Remainder of TSA (see Table 70 for a description of how spatially explicit OGMA's and MMA's are being created)	Prevent harvest of script generated old and mature retention areas. (seral requirements are turned off)	Release retention areas and apply seral requirements. Low BEO areas have a 2/3 old seral requirement applied.	Maintain seral requirements on all BEO areas. Increase requirement on Low BEO areas to full target.

Planning Horizon (250 yrs)

14.5.1.1 Disturbance of Areas Outside the THLB

As crown forested stands in the non-THLB contribute toward several forest cover objectives (i.e. landscape level biodiversity), it was important that the age class distributions in these stands remain consistent with natural processes. By implementing disturbance in these stands, a natural age class distribution was maintained in the model and a realistic contribution toward seral goals ensured.

Assuming that disturbance occurs independently of stand age, a constant area was disturbed annually in each LU/NDT combination on a random basis. The amount of disturbance in each LU/NDT combination was based on the BEC variants present and their associated natural disturbance intervals and old seral definitions as outlined in the *Biodiversity Guidebook* (September 1995) and Table 67.

Using the negative exponential equation, the proportion of the forest that would typically occur as old seral forest can be calculated based on the disturbance interval (% area old = exp(-[old age / interval]). Using this % area in old, the calculation of an effective rotation age associated with this seral distribution is possible (Effective rotation age = interval / (1 – proportion old)). The effective rotation age can then be used to define an annual area of disturbance. For example, ESSF variants in NDT3 have a disturbance interval of 150 yrs and an old definition of 140 yrs. This translates into a typical age class distribution where 39% of the area is "old" (>140 yrs) and the oldest stands are around 230 years. Thus $1/230^{th}$ of the area needed to be disturbed each year to maintain this age class distribution.

The Base Case included:

- Annual disturbance of the Non-THLB area in each LU as shown in Table 68. The stands to be disturbed were randomly selected whenever possible and were modeled at the LU/NDT level.
- Application of an old seral stage requirement (% old used to define the disturbance amount in Table 67). This ensured that a desired age class distribution was achieved in the model, and that a range of stand ages were disturbed.

This methodology is a slight simplification of Option 4 in *Modeling Options for Disturbance Outside the THLB - Working Paper* (MoF, June 2003). Modeling of disturbance at the LU/BEC variant level was simplified to the LU/NDT level in order to minimize the number of modeled zones while ensuring that each zone had a single old seral age.

Table 67. Calculation of area to be disturbed annually in forested non-THLB by BEC/NDT

BEC *	NDT*	Disturbance Interval (yrs)	"OLD" Defn (yrs)	% Area > OLD**	Effective Rotation Age (yrs)**	Contributing Non-THLB Area (ha)	Annual Area Disturbed (ha)***
ESSF	3	150	140	39%	246	174,271	708
ESSF	2	200	250	29%	282	54,277	192
ICH	3	150	140	39%	246	45,302	184
IDF	4	250	250	37%	397	11,432	29
MS	3	150	140	39%	246	53,422	217
PP	4	250	250	37%	297	3,598	12
Totals						**342,302**	**1342**

* Variants within the BEC/NDT combinations shown were treated the same.

** % area old = exp (-[old age / distbance interval]). Effective rotation age = interval / (1 – % area old)

*** Annual area disturbed = Non-THLB area / rotation age

Table 68. Areas to be disturbed annually in the forested non-THLB by LU

LU	Annual Area Disturbed (ha)	LU	Annual Area Disturbed (ha)	LU	Annual Area Disturbed (ha)
C01	24	C14	57	C27	62
C02	47	C15	54	C28	57
C03	14	C16	66	C29	55
C04	53	C17	32	C30	13
C05	62	C18	88	C31	16
C06	66	C19	9	C32	3
C07	39	C20	25	C33	7
C08	35	C21	33	C34	6
C09	30	C22	65	C35	1
C10	23	C23	79	C36	7
C11	18	C24	42	C37	9
C12	17	C25	29	C38	2
C13	36	C26	55		

14.5.2 Stand-level biodiversity — wildlife tree retention

Wildlife tree retention is one of the primary methods to address stand level biodiversity objectives. Section 3.2 and Appendix 3 of the *Landscape Unit Planning Guide* (March 1999) detailed the process for determining wildlife tree retention requirements at the subzone level in order to establish LU objectives. On May 15, 2000, the Assistant Deputy Ministers of Forests and Environment, Lands and Parks (now MSRM) approved changes to Section 3.2 of the *Landscape Unit Planning Guide*. Detailed policy on management of wildlife trees is provided in the document *Provincial Wildlife Tree Policy and Management Recommendations* (MoF/WLAP, February, 2000).

WTP retention calculations based on old BEC linework are currently being utilized for operational planning in the Cranbrook TSA (Gary Dolynchuk, MoF 2003). However, this analysis utilizes the new BEC linework so new values were generated using the methodology outlined in the Landscape Unit Planning Guide. The resulting WTP requirements by LU and BEC are shown in Table 69.

Table 69. Wildlife tree retention requirements by LU and BEC variant

Landscape Units		ESSF dk	ESSF dkp	ESSF dm	ESSF dmu	ESSF wm	ESSF wmu	ICH dm	ICH dw	ICH mk 1	IDF dm 2	MS dk	PP dh 2
1	Moyie Lake	5.5		6.5				5.5	4	7	5.5	8	
2	Perry - Moyie	6.5		7	1.5					5	7	7	
3	Lamb Creek			8.5				9.5		7.5		7.5	
4	Hellroaring - Meach	6		4	1.5	3.75		6.5		11			
5	Redding Creek					0.5	6	3		4			
6	Upper St. Mary's					3		4.5		3			
7	White Creek			2.75				2.5		5	6.5		
8	Kimberley Watershed	5		4				5		6	9.5	6	
9	Yahk River	6		11.5				7.5		5		7.5	
10	Bloom - Caven	6.5						6			7.75	8.5	
11	Teepee Creek	7.5						10		7.5	7	8	
12	Cranbrook Watershed	5.5									7	7	
13	Galton Range	1.2									5	2	
14	Wigwam River											4	
15	Lodgepole - Bighorn	7.5				5	0.25			4.5	12.5	2.5	
16	West Flathead	7.75										5	
17	Upper Flathead	3										8	
18	East Flathead	2.5										6	
19	Corbin Creek	2	1										
20	Alexander - Line	2.5										5	
21	Fording River	2										4.5	
22	Upper Elk	0.5										5	
23	West Elk	0.25										4	
24	Lower Elk					0.25	3.5			1.5		0.5	
25	Sand Creek	1				2.5		2			2	0.5	
26	Iron - Sulphur	2.5				0.75				2.5		3.5	
27	Upper Bull	3.5										4.5	
28	Galbraith - Dibble	2				4	1	6		4		5	
29	Wildhorse - Steeples	4.75									4	2.5	
30	Cranbrook	5									7.5	6	6.5
31	Lost Dog - Mather	1									6.5	7	
32	St. Mary's Prairie -										7.5		8.5
33	Wasa - Picture Valle										6.5		6
34	Jaffray - Baynes Lak										8		7
35	Tobacco Plains										10		9
36	Mayook - Wardner	4.5									7	6.5	6.5
37	Linklater - Englishm	5.5									7	7.5	7
38	East Elk											4	

Occasionally, volume is retained in cutblocks at levels above that required for wildlife tree retention for a variety of forest management considerations (visuals, UWR, seed trees, etc). Where this volume is in the THLB, and there is no expectation to remove it before the start of the next rotation, it must be accounted for in the timber supply model. For purposes of this analysis, a 2.7% total yield reduction was applied to account for both WTP requirements and in-block volume retention as described in Section 4.6.

For reference purposes only, the results of a GIS WTP assessment process is provided in the Appendix and indicates 1.5% of the THLB area should be excluded to meet WTP requirements. The results also indicate that many of the LU/BEC zones are well in excess of the WTP area requirements as a result of retention for OGMA's, MMA's, existing WTP's, riparian areas, and other forested netdowns. This WTP reduction was considered when conducting the in-block volume retention study.

14.5.3 Coarse woody debris

Management of Coarse Woody Debris (CWD) is another important factor in the management of stand level biodiversity. As per provincial policy, it was assumed that CWD objectives are managed operationally within harvesting utilization standards.

14.5.4 Objectives for patch size distribution

Patch size management was adopted in the TSA in an effort to more closely mimic natural disturbance patterns and minimize fragmentation of the land base. Patch size management attempts to achieve the patch size distributions specified in the Landscape Unit Planning Guide (MoF/MoE 1999), and is an alternative to cut block adjacency green-up objectives. As stated in Section 7.1, cut block green-up requirements (adjacency) cannot be modeled directly in the timber supply model so landscape level forest cover objectives are used to approximate these requirements. As patch management is also a spatial issue beyond the resolution of this timber supply analysis, the same landscape level objectives will be used to approximate patch management requirements. Detailed spatial analyses completed during previous projects have confirmed that these landscape level forest cover objectives are consistent with the flexibility associated with patch size management and the operational application of green-up requirements

14.5.5 Objectives for connectivity

As discussed under Section 14.5.1, connectivity corridors were identified under the HLPO and are to be considered high priority when allocating old and mature forest retention areas. This spatial allocation of old and mature retention area addressees the connectivity requirements of the HLPO. The old and mature seral requirements were translated into spatially explicit retention area as per the following logic developed by MSRM Nelson (Tom Volkers):

Table 70. Logic used to create spatially explicit OGMA's

Priorities for Old Seral Deployment	Priorities for Mature Seral Deployment
1. Old in **Parks** (as included in specific LU's)	1. Mature or older in **Parks** (as included in specific LU's)
2. Old **non-Pl**-leading in **Connectivity** on slopes less than 80% (or Important Grizzly Bear Habitat) in **Non-Contributing** areas	2. Mature or older **non-Pl**-leading in **Connectivity** on slopes less than 80% (or Important Grizzly Bear Habitat) in **Non-Contributing** areas
3. Old **non-Pl**-leading in **Connectivity** on slopes less than 80% (or Important Grizzly Bear Habitat) in **THLB** areas	3. Mature or older **non-Pl**-leading in **Connectivity** on slopes less than 80% (or Important Grizzly Bear Habitat) in **THLB** areas
4. Old **non-Pl**-leading in **Caribou** on slopes less than 80% in **Non-Contributing** areas	4. Mature or older **non-Pl**-leading in **Caribou** on slopes less than 80% in **Non-Contributing** areas
5. Old **non-Pl**-leading in **Non-Contributing**	5. Mature or older **non-Pl**-leading in **Non-Contributing**
6. Old **non-Pl**-leading on slopes less that 80% in **Caribou** in **THLB** areas	6. Mature or older **non-Pl**-leading on slopes less that 80% in **Caribou** in **THLB** areas
7. Old **non-Pl** in constrained **THLB** (e.g. VQO, UWR, CWS, DWS, NDT4 Open Forest)	7. Mature or older **non-Pl** in constrained **THLB** (e.g. VQO, UWR, CWS, DWS, NDT4 Open Forest)
8. Old **non-Pl** in the remaining **THLB**	8. Mature or older **non-Pl** in the remaining **THLB**
9. Old **Pl leading** in **Non-Contributing** [Select by age class in the following order: 1) Connectivity 2) Important Grizzly Bear Habitat 3) Caribou, 4) other - all on the basis of oldest first within each category.]	9. **Mid-seral non-Pl** leading [Select oldest first, then within connectivity, regardless of whether in NC or THLB (i.e. recruitment)]
10. **Mature non-Pl** leading [Select oldest first, then within connectivity, regardless of whether in NC or THLB (i.e. recruitment)]	
11. **Mid-seral non-Pl** leading [Select oldest first, then within connectivity, regardless of whether in NC or THLB (i.e. recruitment)]	

Note: Pl leading stands in the THLB were never selected for old or mature seral retention areas.

14.6 Watersheds

14.6.1 Community and domestic watersheds

Based on advice from the MoF hydrologist[56] in the Kootenay Region, community watersheds and domestic watersheds were modeled in the same manner. A forest cover requirement that approximates a 30% Equivalent Clearcut Area (ECA) was implemented (Max 30% < 6m ht) within the crown forested area of each domestic or community watershed. See Table 71 for details.

In addition, forest cover polygons containing a water intake were removed from the land base (ESA1-h) and unstable terrain netdowns were given special consideration in these areas, resulting in less working land base within these types of watersheds.

Table 71. Forest cover requirement for domestic and community watersheds

Watershed Type	Forest cover objectives	Area of Application	Comments
Community Watersheds	Max 30% < 6m (22 yrs)	Crown forested area within each LU by watershed type (CWS / DWS)	Mark Creek watershed will have additional area based constraint applied (max 634 ha / decade).
Domestic Watershed – Class 1	Max 30% < 6m (22 yrs)		
Domestic Watershed – Class 2	Max 30% < 6m (22 yrs)		
Domestic Watershed – Class 3	Max 30% < 6m (22 yrs)		
Domestic Watershed – Class 3s	Max 30% < 6m (22 yrs)		

An Integrated Watershed Management Plan has been completed for the Mark Creek watershed – Kimberley's main community watershed. This plan specifies that harvesting should be limited to approximately 317 ha over a five-year period. In this analysis, harvesting was limited to a maximum of 63.4 ha per year.

14.6.2 Other Watershed Issues

The Wigwam River was identified by the District Manager of the Rocky Mountain Forest District as a high value fisheries watershed for bulltrout. As such, an ECA of 30% was applied to the area represented by the Wigwam landscape unit (14). As discussed above, the best approximation of this in the timber supply model was a requirement that limits the area under six meters to 30% (Max 30%< 22 yrs).

14.7 Lakeshore management zones

In general, riparian management were predominately be addressed through a netdown process that reflected both the reserve and management zones (Section 9.4.8.3). However, lakes larger than 5 ha (L1 lakes) have a 200 meter management zone that is better modeled using forest cover requirements. The 10m reserve zone on L1 lakes < 1000ha was addressed through riparian netdowns. The 200m Lakeshore Management Zone (LMZ) was managed for visual quality and had a forest cover requirement limiting the area under 5m (17yrs) to a maximum of 15%. The only exceptions are L1 lakes in the NDT4, where partial harvesting practices that mimic Open Range and Open Forest are employed and no additional cover requirements are necessary.

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[56] Dave Gluns, Ministry of Forests Research Hydrologist, Nelson BC

15.0 Timber Harvesting

15.1 Harvest flow objectives for Base Case

Harvest flow policy for the base case was generally guided by provincial policy with a few principles that shape how the final analysis was conducted. This policy ensures that current harvest practices do not unduly impact the harvest opportunities or environment of future generations. As per provincial guidelines, the base case analysis included different harvest flows considerations, but in general:

- transitions from short-term to medium- and long-term harvests, avoided large and abrupt disruptions in supply (generally increased and decreased in steps of 10% per period).
- managed the degree to which mid-term timber supply drops below the long-term sustainable harvest level, avoiding very deep mid-term reductions in harvest, and;
- correctly chose the timing of increase to the long-term sustainable timber supply if it was higher than mid-term levels. Long-term harvest levels were generally non-declining and began at the period in which the majority of the harvest contribution was coming from managed stands.

15.2 Minimum harvestable age / merchantability standards

For this analysis, minimum harvestable ages were defined by the following economic criteria:[57]

- minimum volume per hectare (150 m3/ha, or 100m3/ha for Pl on slopes <40%), and
- minimum piece size (25cm mean DBH or 20cm mean DBH for Pl on slopes < 40% for largest 250 stems), and
- age at which 95% of the culmination of the mean annual increment (CMAI) was achieved,
- Problem forest type analysis units to be grown on extended rotations had an additional 20 years added to the minimum harvest age to allow these stands to reach a merchantable size.

In order for the stand within the timber supply model to be considered for harvesting, it had to achieve an age where the criteria described above are achieved. This is a tool to assist the timber supply model to harvest only stands that have reasonable economic criteria, and emulate what is generally current practice by forest licensees. Note that these were minimum criteria, not the actual ages at which stands are forecast for harvest. Some stands may have been harvested at the minimum thresholds to meet forest-level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large fluctuations in harvest levels). However, other stands may not have been harvested until well past these "optimal" timber production ages due to management objectives for other resource values such as requirements for the retention of older forest, or ungulate winter range.

The minimum harvest age utilized for each analysis unit is defined in Table 72. For a detailed description of all analysis unit definitions, see Table 45.

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[57] Agreed to during conference call – DFAM Licensees and MoF, September 3, 2003

Table 72. Minimum harvest ages

Analysis unit (AU)	AU #	Modeled Minimum harvest age (years)		Age to achieve minimum volume* (yrs)		Age to achieve minimum diameter* (yrs)		Age to achieve 95% of Maximum MAI (yrs)	
		Natural	Managed	Natural	Managed	Natural	Managed	Natural	Managed
Natural Stands and Associated Future Managed Stands									
FdPy, Py	101, 201	**100**	**100**	80	80	70	70	100	100
FdPy, Py - Ext Rotation	102	**120**	-	120	-	-	-	-	-
FdOthers – Poor	103, 203	**160**	**130**	160	130	90	120	120	120
FdOthers – Mod	104, 204	**105**	**95**	105	85	80	80	105	95
FdOthers – High	105, 205	**90**	**75**	70	55	70	60	90	75
SB – Poor	106, 206	**125**	**115**	120	90	100	90	125	115
SB – Mod	107, 207	**90**	**85**	85	65	80	60	90	85
SB – High	108, 208	**75**	**65**	65	45	70	50	75	65
CH (All Sites)	109, 209	**80**	**95**	75	75	70	80	80	95
Pl Poor – slopes 0-40%	110, 210	**100**	**100**	80	75	100	70	100	100
Pl Mod – slopes 0-40%	111, 211	**80**	**75**	55	50	80	50	80	75
Pl High – slopes 0-40%	112, 212	**70**	**60**	45	35	70	40	60	60
Pl Ext Rotation	113, 213	**120**	**80**	65	60	100	60	90	80
Pl Poor – slopes >40%	114, 214	**170**	**95**	95	80	170	90	100	95
Pl Mod – slopes >40%	115, 215	**130**	**75**	75	60	130	70	80	75
Pl High – slopes >40%	116, 216	**110**	**60**	55	45	110	50	60	60
Lw – Poor	117, 217	**135**	**125**	135	125	110	120	125	125
Lw – Mod	118, 218	**115**	**95**	95	80	90	80	115	95
Lw – High	119, 219	**100**	**75**	75	55	70	60	100	75
FMER-OR	150	**120**	-	-	-	-	-	-	-
FMER-OR	152	**140**	-	-	-	-	-	-	-
FMER-OF	151, 251	**110**	**n/a**	110	-	80	-	110	-
FMER-OF	153, 251	**130**	**n/a**	-	-	-	-	-	-
Existing Managed Stands and Associated Future Managed Stands									
FdPy, Py	501, 601	**130**	**130**	-	-	-	-	-	-
FdOthers	502, 602	**80**	**80**	65	65	80	80	70	70
SB	503, 603	**75**	**60**	60	50	70	60	75	55
CH	504, 604	**90**	**85**	75	70	80	80	90	85
Pl – Slopes 0-40%	505, 605	**65**	**65**	50	45	50	50	65	65
Pl – Slopes >40%	506, 606	**70**	**70**	55	55	70	70	65	65
Lw	507, 607	**70**	**70**	60	60	70	60	70	70

* Defined in Table 34 (page 88)

15.3 Harvest systems

Harvesting in the Cranbrook TSA is almost entirely completed by conventional ground based harvest, or through cable systems. Cable systems are used on steeper slopes, where ground based methods will not work. Stands eligible for cable harvesting are separated by slopes greater than 50% - a 40% slope break has been used in the analysis in recognition that ground based systems have higher costs when working on steeper slopes. Cable harvest stands have higher site index thresholds for low site stands, and have longer rotations for pine stands, to allow more time for trees to attain a merchantable size.

The table below summarizes the breakdown of harvest systems within the TSA.

Table 73. Harvest methods

Harvest method	Historic harvest contribution (%)
Ground-based (e.g., skidder)	86%
Cable	12%
Helicopter	2%

15.4 Initial harvest rate

The base case harvest forecast used the following initial harvest rates at time 0 of the forecast.

- Initial Harvest: 838,000 m^3/yr (current AAC) + Unsalvaged losses (77,241 m^3/yr) + 70,000 m^3/yr (fire salvage uplift) = 985,241 m^3/yr

The fire salvage uplift is for 3 years only, after which the harvest level returns to:

- Initial Harvest: 838,000 m^3/yr (current AAC) + Unsalvaged losses (77,241 m^3/yr = 915,241 m^3/yr

This initial rate of harvest did not include any volume attributed to partition cuts – it was realised solely from the THLB. Partition harvests come entirely from the non-timber harvesting land base.

15.5 Harvest priorities and rules

Harvest rules were used in this analysis, with the goal of achieving a mean harvest age that closely resembled current management. With numerous pressures from bark beetle infestations and fires, forest licensees were not always necessarily harvesting the oldest stands available for harvest first. A summary of harvest data and Forest Development Plan by the Rocky Mountain Forest District data revealed the following information about the current harvest in the TSA:

Historical (last 8 yrs) Harvest:	60% Pl leading - mean age of 100, 40% other - mean age of 131 yrs **Mean harvest age = 112 yrs**
Planned (5 yrs FDP) Harvest:	75% Pl leading - mean age of 97 25% other - mean age of 147 **Mean harvest age = 109 yrs**

The goal for the analysis was to achieve a short-term mean harvest age of approximately 110 years during the initial harvest periods in order to reflect current practices. To achieve this, the harvest priorities in the table below were used in the timber supply model.

Table 74. Harvest priority rules

Harvest priority	Description
1. Fire salvage	Fire salvage stands from the 2003 fire were top priority for 3 years and then became unavailable.
2. Young Pine leading stands	Pine leading stands have been under attack by mountain pine beetle – and young have been targeted by licensees for harvest and salvage. These stands (stands <110 yrs of age) had a high priority for harvest.
3. OF/OR restoration	Open Range and Open Forest stands within the Timber Harvesting Land base
4. Oldest first	The oldest stands available in the THLB after ensuring all forest cover requirements are met.

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Appendix C – Wildlife Tree Patch Requirements

Existing mapped wildlife trees was removed from the land base through netdowns. The areas of mature forested netdowns (riparian, low sites, unstable areas, OGMAs, etc) were assumed to contribute toward WTP requirements. Additional areas of WTP retention required within each LU/BEC variant combination was determined using the following methodology:

(FOR REFERENCE ONLY - NOT USED IN BASE CASE)

1. The crown forested areas excluded from timber harvesting (including OGMAs/MMAs) over 80 years old were buffered by 250 m. This identified areas within the THLB that did not meet the 500m spacing rule for wildlife tree retention. Any additional area of WTP's required to meet spacing requirements was calculated for each LU/BEC variant as: ha requiring WTPs x WTPtarget %.
2. The total area of forested reserve + additional WTP was then compared to the required target area. For the LU's shown to be in deficit, the additional area required was calculated.
3. For each LU/BEC variant, the total additional WTP requirement (steps 2 and 3) was calculated as a percent of the THLB area. These values were then rolled up to the TSA level by calculating an average additional WTP requirement (weighted by THLB area of each LU/BEC variant) for the THLB.

The result indicated that 1.5% of the THLB was required to meet future WTP requirements.

Cranbrook WTP Retention Calculations

			A	B	C	D	E	F (AxE)	G	H	I (HxE)	J (F-G-I)	K (I+J)	(K/B)
LU	LU_NAME	BEC Variant	CFLB (ha)	THLB (ha)	% Logged no WTP	% Available For Harvest	Gross WTP %	WTP Required HA	CFLB Forest Netdown HA	THLB outside 250m buffer (ha)	Addnl WTP Required for Spacing	WTP Deficit	Total Additional WTP Required	% Additional WTP Required
C01	Moyie Lake	ESSFdk	4,569	3,137	17	69	5.5	251.3	1,432.5	494.5	27.2	0.0	27.2	0.9%
C01	Moyie Lake	ESSFdm	3,808	2,974	16	78	6.5	247.5	833.9	842.5	54.8	0.0	54.8	1.8%
C01	Moyie Lake	ICH dm	9,818	7,595	7	77	5.5	540.0	2,223.2	1,375.7	75.7	0.0	75.7	1.0%
C01	Moyie Lake	ICH dw	2,967	1,822	11	61	4	118.7	1,145.0	255.3	10.2	0.0	10.2	0.6%
C01	Moyie Lake	ICH mk 1	1,569	1,172	24	75	7	109.8	396.6	180.8	12.7	0.0	12.7	1.1%
C01	Moyie Lake	IDF dm 2	464	340	9	73	5.5	25.5	123.5	31.4	1.7	0.0	1.7	0.5%
C01	Moyie Lake	MS dk	671	603	19	90	8	53.7	67.3	55.7	4.5	0.0	4.5	0.7%
C02	Perry - Moyie	ESSFdk	15,555	12,053	21	77	6.5	1,011.1	3,502.2	3,102.0	201.6	0.0	201.6	1.7%
C02	Perry - Moyie	ESSFdkp	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C02	Perry - Moyie	ESSFdku	1,495	612	11	41	2	29.9	883.2	81.0	1.6	0.0	1.6	0.3%
C02	Perry - Moyie	ESSFdm	10,957	7,624	31	70	7	767.0	3,333.0	1,800.5	126.0	0.0	126.0	1.7%
C02	Perry - Moyie	ESSFdmu	287	100	0	35	1.5	4.3	187.8	5.0	0.1	0.0	0.1	0.1%
C02	Perry - Moyie	ICH dm	255	145	0	0	0	0.0	109.4	0.0	0.0	0.0	0.0	0.0%
C02	Perry - Moyie	ICH mk 1	788	375	29	50	5	39.4	413.6	23.1	1.2	0.0	1.2	0.3%
C02	Perry - Moyie	IDF dm 2	2,028	1,553	19	80	7	141.9	475.0	540.2	37.8	0.0	37.8	2.4%
C02	Perry - Moyie	MS dk	12,500	9,464	24	76	7	875.0	3,036.7	2,639.7	184.8	0.0	184.8	2.0%
C02	Perry - Moyie	PP dh 2	16	4	0	0	0	0.0	13.0	0.0	0.0	0.0	0.0	0.0%
C03	Lamb Creek	ESSFdm	5,365	3,459	49	64	8.5	456.0	1,905.2	706.2	60.0	0.0	60.0	1.7%
C03	Lamb Creek	ICH dm	5,306	4,110	52	77	9.5	504.0	1,195.8	561.6	53.3	0.0	53.3	1.3%
C03	Lamb Creek	ICH mk 1	793	541	33	68	7.5	59.5	252.2	61.1	4.6	0.0	4.6	0.8%
C03	Lamb Creek	IDF dm 2	17	17	0	0	0	0.0	0.4	0.0	0.0	0.0	0.0	0.0%
C03	Lamb Creek	MS dk	86	79	13	93	7.5	6.4	6.6	6.5	0.5	0.0	0.5	0.6%
C04	Hellroaring - Meach	AT un	2	0	0	0	0	0.0	2.3	0.0	0.0	0.0	0.0	0.0%
C04	Hellroaring - Meach	ESSFdk	817	652	0	79	6	49.0	165.0	124.8	7.5	0.0	7.5	1.1%
C04	Hellroaring - Meach	ESSFdku	10	0	0	0	0	0.0	10.2	0.0	0.0	0.0	0.0	0.0%
C04	Hellroaring - Meach	ESSFdm	10,683	5,393	19	50	4	427.3	5,289.3	1,004.7	40.2	0.0	40.2	0.7%
C04	Hellroaring - Meach	ESSFdmp	10	0	0	0	0	0.0	10.0	0.0	0.0	0.0	0.0	0.0%
C04	Hellroaring - Meach	ESSFdmu	1,630	531	8	33	1.5	24.5	1,099.5	110.1	1.7	0.0	1.7	0.3%
C04	Hellroaring - Meach	ESSFwm	5,204	1,104	48	21	3.75	195.1	4,100.0	19.6	0.7	0.0	0.7	0.1%
C04	Hellroaring - Meach	ESSFwmp	100	0	0	0	0	0.0	99.9	0.0	0.0	0.0	0.0	0.0%
C04	Hellroaring - Meach	ESSFwmu	737	0	0	0	0	0.0	736.6	0.0	0.0	0.0	0.0	0.0%
C04	Hellroaring - Meach	ICH dm	5,563	3,551	30	64	6.5	361.6	2,012.0	476.3	31.0	0.0	31.0	0.9%
C04	Hellroaring - Meach	ICH mk 1	1,381	1,118	57	81	11	151.9	262.3	241.7	26.6	0.0	26.6	2.4%
C05	Redding Creek	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C05	Redding Creek	ESSFwm	13,633	1,813	21	13	0.5	68.2	11,819.8	84.4	0.4	0.0	0.4	0.0%
C05	Redding Creek	ESSFwmp	187	0	0	0	0	0.0	186.6	0.0	0.0	0.0	0.0	0.0%
C05	Redding Creek	ESSFwmu	2,303	12	78	1	6	138.2	2,291.5	0.0	0.0	0.0	0.0	0.0%
C05	Redding Creek	ICH dm	5,822	3,030	2	52	3	174.6	2,791.8	285.0	8.5	0.0	8.5	0.3%
C05	Redding Creek	ICH mk 1	281	167	10	59	4	11.2	113.7	0.8	0.0	0.0	0.0	0.0%
C06	Upper St. Mary's	AT un	29	0	0	0	0	0.0	28.9	0.0	0.0	0.0	0.0	0.0%
C06	Upper St. Mary's	ESSFwm	14,736	1,764	50	12	3	442.1	12,971.4	239.9	7.2	0.0	7.2	0.4%
C06	Upper St. Mary's	ESSFwmp	68	0	0	0	0	0.0	68.2	0.0	0.0	0.0	0.0	0.0%
C06	Upper St. Mary's	ESSFwmu	1,015	0	0	0	0	0.0	1,014.9	0.0	0.0	0.0	0.0	0.0%
C06	Upper St. Mary's	ICH dm	8,357	4,182	26	50	4.5	376.1	4,174.9	529.1	23.8	0.0	23.8	0.6%
C06	Upper St. Mary's	ICH mk 1	171	82	0	48	3	5.1	89.1	17.2	0.5	0.0	0.5	0.6%
C07	White Creek	AT un	18	0	0	0	0	0.0	18.1	0.0	0.0	0.0	0.0	0.0%
C07	White Creek	ESSFdm	2,193	202	48	9	2.75	60.3	1,991.5	79.2	2.2	0.0	2.2	1.1%
C07	White Creek	ESSFdmp	58	0	0	0	0	0.0	57.9	0.0	0.0	0.0	0.0	0.0%
C07	White Creek	ESSFdmu	456	0	0	0	0	0.0	455.7	0.0	0.0	0.0	0.0	0.0%
C07	White Creek	ESSFwm	3,857	86	0	2	0	0.0	3,771.3	0.0	0.0	0.0	0.0	0.0%
C07	White Creek	ESSFwmp	5	0	0	0	0	0.0	5.1	0.0	0.0	0.0	0.0	0.0%
C07	White Creek	ESSFwmu	491	0	0	0	0	0.0	490.9	0.0	0.0	0.0	0.0	0.0%
C07	White Creek	ICH dm	5,456	2,345	7	43	2.5	136.4	3,110.3	209.0	5.2	0.0	5.2	0.2%
C07	White Creek	ICH mk 1	1,467	935	16	64	5	73.3	531.8	37.2	1.9	0.0	1.9	0.2%
C07	White Creek	IDF dm 2	353	181	30	63	6.5	22.9	171.7	1.2	0.1	0.0	0.1	0.0%
C08	Kimberley Watershed	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C08	Kimberley Watershed	ESSFdk	7,077	5,045	0	71	5	353.9	2,032.0	1,138.7	56.9	0.0	56.9	1.1%
C08	Kimberley Watershed	ESSFdkp	15	0	0	0	0	0.0	14.5	0.0	0.0	0.0	0.0	0.0%
C08	Kimberley Watershed	ESSFdku	716	13	0	2	0	0.0	703.0	3.4	0.0	0.0	0.0	0.0%
C08	Kimberley Watershed	ESSFdm	5,459	2,391	24	44	4	218.4	3,068.2	518.8	20.8	0.0	20.8	0.9%
C08	Kimberley Watershed	ESSFdmp	141	0	0	0	0	0.0	140.7	0.0	0.0	0.0	0.0	0.0%
C08	Kimberley Watershed	ESSFdmu	1,621	170	3	10	0	0.0	1,451.8	15.0	0.0	0.0	0.0	0.0%
C08	Kimberley Watershed	ICH dm	1,074	555	29	52	5	53.7	519.8	96.1	4.8	0.0	4.8	0.9%
C08	Kimberley Watershed	ICH mk 1	130	93	23	72	6	7.8	36.6	15.6	0.9	0.0	0.9	1.0%

			A	B	C	D	E	F (AxE)	G	H	I (HxE)	J (F-G-I)	K (I+J)	(K/B)
LU	LU_NAME	BEC Variant	CFLB (ha)	THLB (ha)	% Logged no WTP	% Available For Harvest	Gross WTP %	WTP Required HA	CFLB Forest Netdown HA	THLB outside 250m buffer (ha)	Addnl WTP Required for Spacing	WTP Deficit	Total Additional WTP Required	% Additional WTP Required
C08	Kimberley Watershed	IDF dm 2	826	702	41	85	9.5	78.5	124.0	141.1	13.4	0.0	13.4	1.9%
C08	Kimberley Watershed	MS dk	4,573	3,587	2	78	6	274.4	986.2	700.8	42.1	0.0	42.1	1.2%
C09	Yahk River	ESSFdk	8,774	6,364	22	73	6	526.4	2,409.5	1,282.9	77.0	0.0	77.0	1.2%
C09	Yahk River	ESSFdm	1,892	1,725	56	91	11.5	217.5	166.3	495.6	57.0	0.0	57.0	3.3%
C09	Yahk River	ICH dm	14,425	11,680	24	81	7.5	1,081.9	2,745.3	2,146.6	161.0	0.0	161.0	1.4%
C09	Yahk River	ICH mk 1	2,327	1,202	32	52	5	116.4	1,125.0	244.0	12.2	0.0	12.2	1.0%
C09	Yahk River	MS dk	5,759	4,883	21	86	7.5	431.9	875.3	903.0	67.7	0.0	67.7	1.4%
C10	Bloom - Caven	ESSFdk	9,025	7,114	14	79	6.5	586.6	1,911.2	2,302.5	149.7	0.0	149.7	2.1%
C10	Bloom - Caven	ESSFdku	63	30	0	0	0	0.0	33.1	0.0	0.0	0.0	0.0	0.0%
C10	Bloom - Caven	ICH dm	3,262	2,561	11	79	6	195.7	700.7	439.9	26.4	0.0	26.4	1.0%
C10	Bloom - Caven	ICH mk 1	5	5	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C10	Bloom - Caven	IDF dm 2	4,075	3,293	27	81	7.75	315.8	781.9	318.0	24.6	0.0	24.6	0.7%
C10	Bloom - Caven	MS dk	15,515	12,998	29	84	8.5	1,318.8	2,517.7	2,917.8	248.0	0.0	248.0	1.9%
C11	Teepee Creek	ESSFdk	9,796	8,011	25	81	7.5	734.7	1,785.4	2,057.9	154.3	0.0	154.3	1.9%
C11	Teepee Creek	ESSFdku	40	2	0	0	0	0.0	37.6	0.0	0.0	0.0	0.0	0.0%
C11	Teepee Creek	ICH dm	727	652	37	90	10	72.7	74.4	171.2	17.1	0.0	17.1	2.6%
C11	Teepee Creek	ICH mk 1	3,260	2,788	22	86	7.5	244.5	471.5	513.9	38.5	0.0	38.5	1.4%
C11	Teepee Creek	IDF dm 2	1,713	1,355	18	79	7	119.9	358.8	271.9	19.0	0.0	19.0	1.4%
C11	Teepee Creek	MS dk	9,960	7,994	30	82	8	796.8	1,966.3	1,700.1	136.0	0.0	136.0	1.7%
C12	Cranbrook Watershed	ESSFdk	9,815	6,795	14	69	5.5	539.8	3,020.2	1,139.6	62.7	0.0	62.7	0.9%
C12	Cranbrook Watershed	ESSFdku	137	33	0	24	0.75	1.0	104.1	0.0	0.0	0.0	0.0	0.0%
C12	Cranbrook Watershed	IDF dm 2	293	278	10	95	7	20.5	15.3	57.3	4.0	1.2	5.2	1.9%
C12	Cranbrook Watershed	MS dk	5,879	4,814	18	82	7	411.5	1,064.2	664.3	46.5	0.0	46.5	1.0%
C13	Galton Range	ESSFdk	6,099	1,045	24	17	1.2	73.2	5,053.2	28.6	0.3	0.0	0.3	0.0%
C13	Galton Range	ESSFdku	325	16	0	5	0	0.0	308.7	0.4	0.0	0.0	0.0	0.0%
C13	Galton Range	IDF dm 2	2,677	1,834	9	69	5	133.8	842.8	548.8	27.4	0.0	27.4	1.5%
C13	Galton Range	MS dk	4,150	1,236	19	30	2	83.0	2,914.5	41.7	0.8	0.0	0.8	0.1%
C13	Galton Range	PP dh 2	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C14	Wigwam River	ESSFdk	11,978	1,354	9	11	0	0.0	10,623.7	29.8	0.0	0.0	0.0	0.0%
C14	Wigwam River	ESSFdkp	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C14	Wigwam River	ESSFdku	680	0	0	0	0	0.0	679.7	0.0	0.0	0.0	0.0	0.0%
C14	Wigwam River	MS dk	6,639	3,917	2	59	4	265.6	2,722.5	330.2	13.2	0.0	13.2	0.3%
C15	Lodgepole - Bighorn	ESSFdk	8,136	2,305	74	28	7.5	610.2	5,831.0	267.4	20.1	0.0	20.1	0.9%
C15	Lodgepole - Bighorn	ESSFdkp	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C15	Lodgepole - Bighorn	ESSFdku	435	5	90	1	7	30.5	430.1	0.0	0.0	0.0	0.0	0.0%
C15	Lodgepole - Bighorn	ESSFwm	2,641	603	56	23	5	132.0	2,038.4	52.4	2.6	0.0	2.6	0.4%
C15	Lodgepole - Bighorn	ESSFwmp	37	0	0	0	0	0.0	37.4	0.0	0.0	0.0	0.0	0.0%
C15	Lodgepole - Bighorn	ESSFwmu	658	35	17	5	0.25	1.6	622.8	0.0	0.0	0.0	0.0	0.0%
C15	Lodgepole - Bighorn	ICH mk 1	3,271	1,137	38	35	4.5	147.2	2,133.9	73.0	3.3	0.0	3.3	0.3%
C15	Lodgepole - Bighorn	IDF dm 2	74	65	68	87	12.5	9.3	9.4	12.8	1.6	0.0	1.6	2.5%
C15	Lodgepole - Bighorn	MS dk	5,002	2,258	10	45	2.5	125.0	2,744.0	141.3	3.5	0.0	3.5	0.2%
C16	West Flathead	ESSFdk	19,865	8,528	63	43	7.75	1,539.5	11,337.2	1,145.6	88.8	0.0	88.8	1.0%
C16	West Flathead	ESSFdkp	52	0	0	0	0	0.0	51.5	0.0	0.0	0.0	0.0	0.0%
C16	West Flathead	ESSFdku	1,006	113	85	11	6.5	65.4	893.0	38.7	2.5	0.0	2.5	2.2%
C16	West Flathead	ESSFwmp	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C16	West Flathead	MS dk	12,194	8,216	7	68	5	609.7	3,978.2	1,133.5	56.7	0.0	56.7	0.7%
C17	Upper Flathead	AT un	0	0	0	0	0	0.0	0.2	0.0	0.0	0.0	0.0	0.0%
C17	Upper Flathead	ESSFdk	10,733	5,193	12	48	3	322.0	5,540.7	439.0	13.2	0.0	13.2	0.3%
C17	Upper Flathead	ESSFdkp	108	0	0	0	0	0.0	108.4	0.0	0.0	0.0	0.0	0.0%
C17	Upper Flathead	ESSFdku	1,899	155	33	8	1.5	28.5	1,744.9	32.2	0.5	0.0	0.5	0.3%
C17	Upper Flathead	ESSFwm	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C17	Upper Flathead	ESSFwmu	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C17	Upper Flathead	MS dk	1,071	689	45	64	8	85.7	381.6	46.6	3.7	0.0	3.7	0.5%
C18	East Flathead	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C18	East Flathead	ESSFdk	19,105	4,400	34	23	2.5	477.6	14,704.6	370.0	9.2	0.0	9.2	0.2%
C18	East Flathead	ESSFdkp	12	0	0	0	0	0.0	11.6	0.0	0.0	0.0	0.0	0.0%
C18	East Flathead	ESSFdku	1,324	0	0	0	0	0.0	1,323.8	0.0	0.0	0.0	0.0	0.0%
C18	East Flathead	MS dk	19,717	14,111	21	72	6	1,183.0	5,605.9	2,454.6	147.3	0.0	147.3	1.0%
C19	Corbin Creek	AT un	4	0	0	0	0	0.0	4.5	0.0	0.0	0.0	0.0	0.0%
C19	Corbin Creek	ESSFdk	2,388	896	1	39	2	47.8	1,491.8	118.2	2.4	0.0	2.4	0.3%
C19	Corbin Creek	ESSFdkp	16	5	0	30	1	0.2	11.0	0.1	0.0	0.0	0.0	0.0%
C19	Corbin Creek	ESSFdku	449	32	0	7	0	0.0	416.2	0.3	0.0	0.0	0.0	0.0%
C19	Corbin Creek	ESSFwm	0	0	0	0	0	0.0	0.3	0.0	0.0	0.0	0.0	0.0%
C19	Corbin Creek	ESSFwmu	7	0	0	0	0	0.0	6.9	0.0	0.0	0.0	0.0	0.0%
C19	Corbin Creek	IDF un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%

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C19	Corbin Creek	MS dk	348	172	0	0	0	0.0	176.2	0.0	0.0	0.0	0.0	0.0%
C20	Alexander - Line	AT un	6	0	0	0	0	0.0	6.3	0.0	0.0	0.0	0.0	0.0%
C20	Alexander - Line	ESSFdk	5,887	1,622	27	28	2.5	147.2	4,264.6	112.2	2.8	0.0	2.8	0.2%
C20	Alexander - Line	ESSFdkp	6	0	0	0	0	0.0	6.1	0.0	0.0	0.0	0.0	0.0%
C20	Alexander - Line	ESSFdku	1,143	83	0	7	0	0.0	1,059.7	15.1	0.0	0.0	0.0	0.0%
C20	Alexander - Line	IDF un	22	0	0	0	0	0.0	21.8	0.0	0.0	0.0	0.0	0.0%
C20	Alexander - Line	MS dk	1,896	1,174	19	61	5	94.8	721.9	112.7	5.6	0.0	5.6	0.5%
C21	Fording River	AT un	15	0	0	0	0	0.0	15.4	0.0	0.0	0.0	0.0	0.0%
C21	Fording River	ESSFdk	8,991	2,998	16	33	2	179.8	5,992.9	269.2	5.4	0.0	5.4	0.2%
C21	Fording River	ESSFdkp	29	0	0	0	0	0.0	29.4	0.0	0.0	0.0	0.0	0.0%
C21	Fording River	ESSFdku	1,686	132	38	8	2	33.7	1,554.4	5.2	0.1	0.0	0.1	0.1%
C21	Fording River	MS dk	805	401	25	50	4.5	36.2	404.0	2.7	0.1	0.0	0.1	0.0%
C22	Upper Elk	AT un	8	0	0	0	0	0.0	8.3	0.0	0.0	0.0	0.0	0.0%
C22	Upper Elk	ESSFdk	15,594	3,080	0	20	0.5	78.0	12,513.9	287.1	1.4	0.0	1.4	0.0%
C22	Upper Elk	ESSFdkp	41	0	0	0	0	0.0	40.7	0.0	0.0	0.0	0.0	0.0%
C22	Upper Elk	ESSFdku	1,947	39	0	2	0	0.0	1,907.5	1.1	0.0	0.0	0.0	0.0%
C22	Upper Elk	MS dk	4,754	3,295	0	69	5	237.7	1,459.2	397.4	19.9	0.0	19.9	0.6%
C23	West Elk	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C23	West Elk	ESSFdk	12,534	598	14	5	0.25	31.3	11,936.3	5.8	0.0	0.0	0.0	0.0%
C23	West Elk	ESSFdkp	126	0	0	0	0	0.0	125.8	0.0	0.0	0.0	0.0	0.0%
C23	West Elk	ESSFdku	2,685	8	0	0	0	0.0	2,676.2	0.0	0.0	0.0	0.0	0.0%
C23	West Elk	MS dk	11,675	6,635	16	57	4	467.0	5,040.0	763.7	30.5	0.0	30.5	0.5%
C24	Lower Elk	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C24	Lower Elk	ESSFdk	598	64	0	11	0	0.0	533.4	0.9	0.0	0.0	0.0	0.0%
C24	Lower Elk	ESSFdkp	27	1	0	5	0	0.0	25.8	0.0	0.0	0.0	0.0	0.0%
C24	Lower Elk	ESSFdku	241	46	0	19	0.5	1.2	195.7	0.0	0.0	0.0	0.0	0.0%
C24	Lower Elk	ESSFwm	2,808	446	9	16	0.25	7.0	2,361.9	11.7	0.0	0.0	0.0	0.0%
C24	Lower Elk	ESSFwmp	177	0	0	0	0	0.0	176.6	0.0	0.0	0.0	0.0	0.0%
C24	Lower Elk	ESSFwmu	707	13	55	2	3.5	24.8	694.1	0.0	0.0	0.0	0.0	0.0%
C24	Lower Elk	ICH mk 1	9,396	3,413	1	36	1.5	140.9	5,983.1	126.6	1.9	0.0	1.9	0.1%
C24	Lower Elk	IDF dm 2	146	27	0	0	0	0.0	118.9	0.0	0.0	0.0	0.0	0.0%
C24	Lower Elk	MS dk	1,288	236	9	18	0.5	6.4	1,052.1	54.3	0.3	0.0	0.3	0.1%
C25	Sand Creek	ESSFdk	1,268	148	28	12	1	12.7	1,120.5	0.1	0.0	0.0	0.0	0.0%
C25	Sand Creek	ESSFdku	161	3	0	2	0	0.0	158.1	0.0	0.0	0.0	0.0	0.0%
C25	Sand Creek	ESSFwm	2,491	233	46	9	2.5	62.3	2,258.0	5.0	0.1	0.0	0.1	0.1%
C25	Sand Creek	ESSFwmp	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C25	Sand Creek	ESSFwmu	119	0	0	0	0	0.0	118.8	0.0	0.0	0.0	0.0	0.0%
C25	Sand Creek	ICH dm	3,263	1,063	20	33	2	65.3	2,199.8	55.0	1.1	0.0	1.1	0.1%
C25	Sand Creek	IDF dm 2	450	178	4	39	2	9.0	272.6	16.9	0.3	0.0	0.3	0.2%
C25	Sand Creek	MS dk	1,894	399	6	21	0.5	9.5	1,495.0	13.9	0.1	0.0	0.1	0.0%
C26	Iron - Sulphur	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C26	Iron - Sulphur	ESSFdk	3,836	956	29	25	2.5	95.9	2,879.5	119.2	3.0	0.0	3.0	0.3%
C26	Iron - Sulphur	ESSFdkp	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C26	Iron - Sulphur	ESSFdku	430	0	0	0	0	0.0	430.1	0.0	0.0	0.0	0.0	0.0%
C26	Iron - Sulphur	ESSFwm	4,562	1,057	9	23	0.75	34.2	3,505.1	66.4	0.5	0.0	0.5	0.0%
C26	Iron - Sulphur	ESSFwmp	28	0	0	0	0	0.0	27.7	0.0	0.0	0.0	0.0	0.0%
C26	Iron - Sulphur	ESSFwmu	405	3	0	1	0	0.0	401.8	0.0	0.0	0.0	0.0	0.0%
C26	Iron - Sulphur	ICH mk 1	10,504	4,659	9	44	2.5	262.6	5,845.0	342.0	8.6	0.0	8.6	0.2%
C26	Iron - Sulphur	IDF dm 2	109	5	0	4	0	0.0	104.0	0.0	0.0	0.0	0.0	0.0%
C26	Iron - Sulphur	MS dk	2,174	1,151	2	53	3.5	76.1	1,023.1	175.5	6.1	0.0	6.1	0.5%
C27	Upper Bull	AT un	0	0	0	0	0	0.0	0.2	0.0	0.0	0.0	0.0	0.0%
C27	Upper Bull	ESSFdk	14,808	4,292	33	29	3.5	518.3	10,515.5	253.9	8.9	0.0	8.9	0.2%
C27	Upper Bull	ESSFdkp	86	0	0	0	0	0.0	85.8	0.0	0.0	0.0	0.0	0.0%
C27	Upper Bull	ESSFdku	1,765	53	65	3	4.5	79.4	1,712.3	0.0	0.0	0.0	0.0	0.0%
C27	Upper Bull	MS dk	8,574	5,552	0	65	4.5	385.8	3,022.4	796.6	35.8	0.0	35.8	0.6%
C28	Galbraith - Dibble	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C28	Galbraith - Dibble	ESSFdk	3,778	1,070	21	28	2	75.6	2,708.3	53.6	1.1	0.0	1.1	0.1%
C28	Galbraith - Dibble	ESSFdkp	1	0	0	0	0	0.0	1.2	0.0	0.0	0.0	0.0	0.0%
C28	Galbraith - Dibble	ESSFdku	287	10	0	4	0	0.0	276.7	0.0	0.0	0.0	0.0	0.0%
C28	Galbraith - Dibble	ESSFwm	6,045	2,053	41	34	4	241.8	3,992.4	360.8	14.4	0.0	14.4	0.7%
C28	Galbraith - Dibble	ESSFwmp	139	0	0	0	0	0.0	138.9	0.0	0.0	0.0	0.0	0.0%
C28	Galbraith - Dibble	ESSFwmu	1,258	177	23	14	1	12.6	1,080.9	49.3	0.5	0.0	0.5	0.3%
C28	Galbraith - Dibble	ICH dm	2,086	936	44	45	6	125.2	1,149.8	29.3	1.8	0.0	1.8	0.2%
C28	Galbraith - Dibble	ICH mk 1	7,982	4,141	21	52	4	319.3	3,840.8	255.7	10.2	0.0	10.2	0.2%
C28	Galbraith - Dibble	IDF dm 2	52	5	0	9	0	0.0	47.4	1.0	0.0	0.0	0.0	0.0%

			A	B	C	D	E	F (AxE)	G	H	I (HxE)	J (F-G-I)	K (I+J)	(K/B)
LU	LU_NAME	BEC Variant	CFLB (ha)	THLB (ha)	% Logged no WTP	% Available For Harvest	Gross WTP %	WTP Required HA	CFLB Forest Netdown HA	THLB outside 250m buffer (ha)	Addnl WTP Required for Spacing	WTP Deficit	Total Additional WTP Required	% Additional WTP Required
C28	Galbraith - Dibble	MS dk	5,272	3,641	0	69	5	263.6	1,631.0	552.7	27.6	0.0	27.6	0.8%
C29	Wildhorse - Steeples	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C29	Wildhorse - Steeples	ESSFdk	9,318	2,800	48	30	4.75	442.6	6,517.3	190.3	9.0	0.0	9.0	0.3%
C29	Wildhorse - Steeples	ESSFdkp	487	0	0	0	0	0.0	487.2	0.0	0.0	0.0	0.0	0.0%
C29	Wildhorse - Steeples	ESSFdku	2,613	160	19	6	0.5	13.1	2,453.0	5.3	0.0	0.0	0.0	0.0%
C29	Wildhorse - Steeples	ESSFwmp	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C29	Wildhorse - Steeples	IDF dm 2	1,191	559	25	47	4	47.6	632.6	82.7	3.3	0.0	3.3	0.6%
C29	Wildhorse - Steeples	MS dk	6,267	1,968	25	31	2.5	156.7	4,298.7	165.7	4.1	0.0	4.1	0.2%
C30	Cranbrook	ESSFdk	739	513	5	69	5	37.0	226.8	62.8	3.1	0.0	3.1	0.6%
C30	Cranbrook	ICH mk 1	183	9	0	0	0	0.0	173.3	0.0	0.0	0.0	0.0	0.0%
C30	Cranbrook	IDF dm 2	11,383	9,937	15	88	7.5	853.7	1,446.5	3,280.1	246.0	0.0	246.0	2.5%
C30	Cranbrook	MS dk	9,187	7,630	8	82	6	551.2	1,557.7	3,182.4	190.9	0.0	190.9	2.5%
C30	Cranbrook	PP dh 2	2,608	2,021	13	78	6.5	169.5	586.7	207.5	13.5	0.0	13.5	0.7%
C31	Lost Dog - Mather	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C31	Lost Dog - Mather	ESSFdk	2,662	800	0	30	1	26.6	1,862.1	37.4	0.4	0.0	0.4	0.0%
C31	Lost Dog - Mather	ESSFdkp	58	0	0	0	0	0.0	58.5	0.0	0.0	0.0	0.0	0.0%
C31	Lost Dog - Mather	ESSFdku	888	0	0	0	0	0.0	888.5	0.0	0.0	0.0	0.0	0.0%
C31	Lost Dog - Mather	IDF dm 2	1,708	1,472	11	86	6.5	111.1	236.9	218.0	14.2	0.0	14.2	1.0%
C31	Lost Dog - Mather	MS dk	9,848	8,869	3	90	7	689.3	978.4	2,714.2	190.0	0.0	190.0	2.1%
C32	St. Mary's Prairie -	IDF dm 2	2,710	2,284	19	85	7.5	203.3	426.1	1,055.0	79.1	0.0	79.1	3.5%
C32	St. Mary's Prairie -	MS dk	275	257	0	0	0	0.0	18.4	0.0	0.0	0.0	0.0	0.0%
C32	St. Mary's Prairie -	PP dh 2	6,406	5,765	24	91	8.5	544.5	640.4	2,210.5	187.9	0.0	187.9	3.3%
C33	Wasa - Picture Valle	IDF dm 2	9,058	7,281	15	81	6.5	588.8	1,777.6	2,510.2	163.2	0.0	163.2	2.2%
C33	Wasa - Picture Valle	MS dk	22	10	0	0	0	0.0	12.0	0.0	0.0	0.0	0.0	0.0%
C33	Wasa - Picture Valle	PP dh 2	5,093	3,976	5	78	6	305.6	1,117.1	1,352.2	81.1	0.0	81.1	2.0%
C34	Jaffray - Baynes Lak	IDF dm 2	18,307	16,400	19	90	8	1,464.6	1,907.3	7,490.9	599.3	0.0	599.3	3.7%
C34	Jaffray - Baynes Lak	MS dk	252	213	0	0	0	0.0	38.9	0.0	0.0	0.0	0.0	0.0%
C34	Jaffray - Baynes Lak	PP dh 2	4,542	4,074	7	90	7	317.9	467.8	2,579.5	180.6	0.0	180.6	4.4%
C35	Tobacco Plains	IDF dm 2	2,322	2,197	40	95	10	232.2	124.8	1,790.9	179.1	0.0	179.1	8.2%
C35	Tobacco Plains	PP dh 2	5,534	5,091	31	93	9	498.1	443.6	3,172.6	285.5	0.0	285.5	5.6%
C36	Mayook - Wardner	ESSFdk	1,868	1,288	1	67	4.5	84.0	579.5	118.0	5.3	0.0	5.3	0.4%
C36	Mayook - Wardner	ESSFdku	42	0	0	0	0	0.0	41.6	0.0	0.0	0.0	0.0	0.0%
C36	Mayook - Wardner	IDF dm 2	5,309	4,921	9	93	7	371.6	387.8	1,097.4	76.8	0.0	76.8	1.6%
C36	Mayook - Wardner	MS dk	6,598	5,744	10	87	6.5	428.9	854.2	813.5	52.9	0.0	52.9	0.9%
C36	Mayook - Wardner	PP dh 2	381	328	0	86	6.5	24.8	53.3	136.8	8.9	0.0	8.9	2.7%
C37	Linklater - Englishm	ESSFdk	3,284	2,228	23	67	5.5	180.6	1,056.2	617.2	33.9	0.0	33.9	1.5%
C37	Linklater - Englishm	ESSFdku	18	0	0	0	0	0.0	18.0	0.0	0.0	0.0	0.0	0.0%
C37	Linklater - Englishm	IDF dm 2	15,345	14,320	11	93	7	1,074.1	1,025.1	4,118.4	288.3	0.0	288.3	2.0%
C37	Linklater - Englishm	MS dk	4,520	4,153	15	92	7.5	339.0	366.9	1,176.5	88.2	0.0	88.2	2.1%
C37	Linklater - Englishm	PP dh 2	3,182	2,906	9	91	7	222.7	275.8	1,313.9	92.0	0.0	92.0	3.2%
C38	East Elk	AT un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C38	East Elk	ESSFdk	3	0	0	0	0	0.0	2.8	0.0	0.0	0.0	0.0	0.0%
C38	East Elk	ESSFdkp	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C38	East Elk	ESSFdku	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C38	East Elk	IDF un	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
C38	East Elk	MS dk	1,015	610	0	60	4	40.6	405.3	6.2	0.2	0.0	0.2	0.0%
Totals			762,170	417,257				36,803.7	344,912.1	90,802.7	6,118.8	1.2	6,120.0	Wtd Avg
														1.5%

Appendix D – Old and Mature Biodiversity Targets

Cranbrook TSA: Landscape Unit Area Summary by BEC Variant

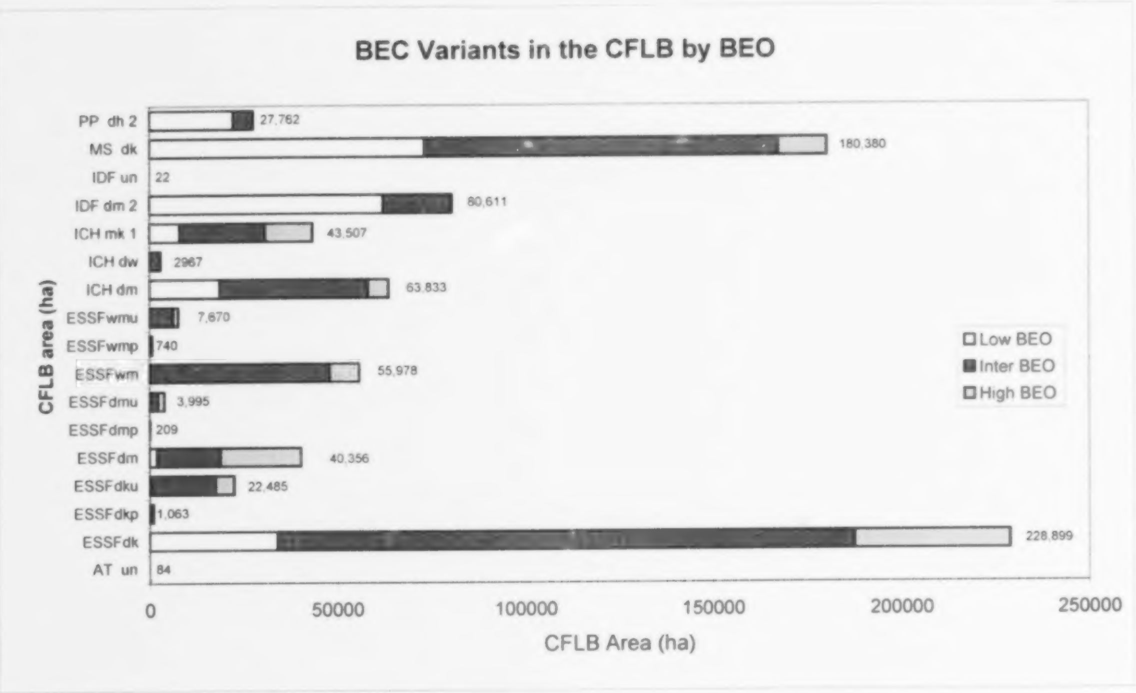
LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	Old Seral Goals			Old + Mature Seral Goals		
								%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
1	Moyie Lake	I	ESSFdk	3	3,137	4,569	5,326	14.0	639.7	641.9			
1	Moyie Lake	I	ESSFdm	3	2,974	3,808	4,208	14.0	533.1	542.1			
1	Moyie Lake	I	ICH dm	3	7,595	9,818	11,287	14.0	1374.5	1379.4			
1	Moyie Lake	I	ICH dw	3	1,822	2,967	4,119	14.0	415.3	416.1			
1	Moyie Lake	I	ICH mk 1	3	1,172	1,569	2,816	14.0	219.6	219.8			
1	Moyie Lake	I	IDF dm 2	4	340	464	1,753	13.0	60.3	64.8			
1	Moyie Lake	I	MS dk	3	603	671	1,003	14.0	93.9	107.2			
Moyie Lake Total					17,643	23,865	30,512		3336.5	3371.4			
2	Perry - Moyie	H	ESSFdk	3	12,053	15,555	17,177	21.0	3266.6	3266.9	34.0	3725.4	3726.6
2	Perry - Moyie	H	ESSFdkp	5	-	-	111						
2	Perry - Moyie	H	ESSFdku	3	612	1,495	2,654	21.0	314.0	316.9			
2	Perry - Moyie	H	ESSFdm	3	7,624	10,957	13,564	21.0	2301.0	2304.0			
2	Perry - Moyie	H	ESSFdmu	3	100	287	992	21.0	60.3	61.4			
2	Perry - Moyie	L	ICH dm	3	145	255	313	4.7	12.0				
2	Perry - Moyie	L	ICH mk 1	3	375	788	902	4.7	37.0	52.6			
2	Perry - Moyie	L	IDF dm 2	4	1,553	2,028	3,374	4.3	87.2	88.1			
2	Perry - Moyie	L	MS dk	3	9,464	12,500	13,998	4.7	587.5	587.8			
2	Perry - Moyie	L	PP dh 2	4	4	16	18	4.3	0.7				
Perry - Moyie Total					31,928	43,882	53,102		6666.3	6677.7		3725.4	3726.6
3	Lamb Creek	I	ESSFdm	3	3,459	5,365	5,911	14.0	751.0	755.0			
3	Lamb Creek	I	ICH dm	3	4,110	5,306	5,944	14.0	742.8	744.1			
3	Lamb Creek	I	ICH mk 1	3	541	793	926	14.0	111.1	119.9			
3	Lamb Creek	I	IDF dm 2	4	17	17	44	13.0	2.3				
3	Lamb Creek	I	MS dk	3	79	86	168	14.0	12.0	14.5			
Lamb Creek Total					8,206	11,566	12,994		1619.1	1633.6			
4	Hellroaring - Meach	H	AT un	5	-	2	1,051				42.0	2185.6	2189.1
4	Hellroaring - Meach	H	ESSFdk	3	652	817	889	21.0	171.7	127.4			
4	Hellroaring - Meach	H	ESSFdku	3	-	10	25	21.0	2.1				
4	Hellroaring - Meach	H	ESSFdm	3	5,393	10,683	12,893	21.0	2243.4	2289.2			
4	Hellroaring - Meach	H	ESSFdmp	5	-	10	497						
4	Hellroaring - Meach	H	ESSFdmu	3	531	1,630	4,059	21.0	342.3	344.4			
4	Hellroaring - Meach	H	ESSFwm	2	1,104	5,204	8,224	13.0	676.5	678.1			
4	Hellroaring - Meach	H	ESSFwmp	5	-	100	1,661						
4	Hellroaring - Meach	H	ESSFwmu	2	-	737	3,261	13.0	95.8	105.6			
4	Hellroaring - Meach	H	ICH dm	3	3,551	5,563	6,662	21.0	1168.2	1169.9			
4	Hellroaring - Meach	L	ICH mk 1	3	1,118	1,381	1,601	4.7	64.9	64.9			
Hellroaring - Meach Total					12,350	26,137	40,822		4764.9	4779.5		2185.6	2189.1
5	Redding Creek	I	AT un	5	-	-	730						
5	Redding Creek	I	ESSFwm	2	1,813	13,633	18,327	9.0	1227.0	1227.9			
5	Redding Creek	I	ESSFwmp	5	-	187	3,493						
5	Redding Creek	I	ESSFwmu	2	12	2,303	8,971	9.0	207.3	207.8			
5	Redding Creek	I	ICH dm	3	3,030	5,822	6,747	14.0	815.0	815.7			
5	Redding Creek	I	ICH mk 1	3	167	281	366	14.0	39.3	39.3			
Redding Creek Total					5,022	22,225	38,634		2288.6	2290.8			
6	Upper St. Mary's	I	AT un	5	-	29	2,412						
6	Upper St. Mary's	I	ESSFwm	2	1,764	14,735	26,968	9.0	1326.2	1359.0			
6	Upper St. Mary's	I	ESSFwmp	5	-	68	5,331						
6	Upper St. Mary's	I	ESSFwmu	2	-	1,015	11,059	9.0	91.3	93.7			
6	Upper St. Mary's	I	ICH dm	3	3,530	7,329	10,163	14.0	1026.0	1170.0			
6	Upper St. Mary's	I	ICH mk 1	3	82	171	335	14.0	24.0	35.3			
Upper St. Mary's Total					5,376	23,347	56,268		2467.5	2658.0			
7	White Creek	I	AT un	5	-	18	3,574						
7	White Creek	I	ESSFdm	3	202	2,193	3,320	14.0	307.0	307.3			
7	White Creek	I	ESSFdmp	5	-	58	1,706						
7	White Creek	I	ESSFdmu	3	-	456	1,968	14.0	63.8	67.2			
7	White Creek	I	ESSFwm	2	86	3,857	7,668	9.0	347.2	359.9			
7	White Creek	I	ESSFwmp	5	-	5	3,789						
7	White Creek	I	ESSFwmu	2	-	491	5,746	9.0	44.2	48.5			
7	White Creek	I	ICH dm	3	1,936	4,905	6,997	14.0	686.7	768.5			
7	White Creek	I	ICH mk 1	3	935	1,467	2,875	14.0	205.4	205.7			
7	White Creek	I	IDF dm 2	4	181	353	472	13.0	45.9	46.9			
White Creek Total					3,341	13,804	38,116		1700.2	1803.9			
8	Kimberley Watershed	I	AT un	5	-	-	346						
8	Kimberley Watershed	I	ESSFdk	3	5,045	7,077	7,900	14.0	990.8	992.0			
8	Kimberley Watershed	I	ESSFdkp	5	-	15	797						
8	Kimberley Watershed	I	ESSFdku	3	13	716	1,485	14.0	100.2	103.6			
8	Kimberley Watershed	I	ESSFdm	3	2,391	5,459	6,417	14.0	764.3	764.6			
8	Kimberley Watershed	I	ESSFdmp	5	-	141	2,033						
8	Kimberley Watershed	I	ESSFdmu	3	170	1,621	3,386	14.0	227.0	231.2			
8	Kimberley Watershed	I	ICH dm	3	555	1,074	1,183	14.0	150.4	151.0			

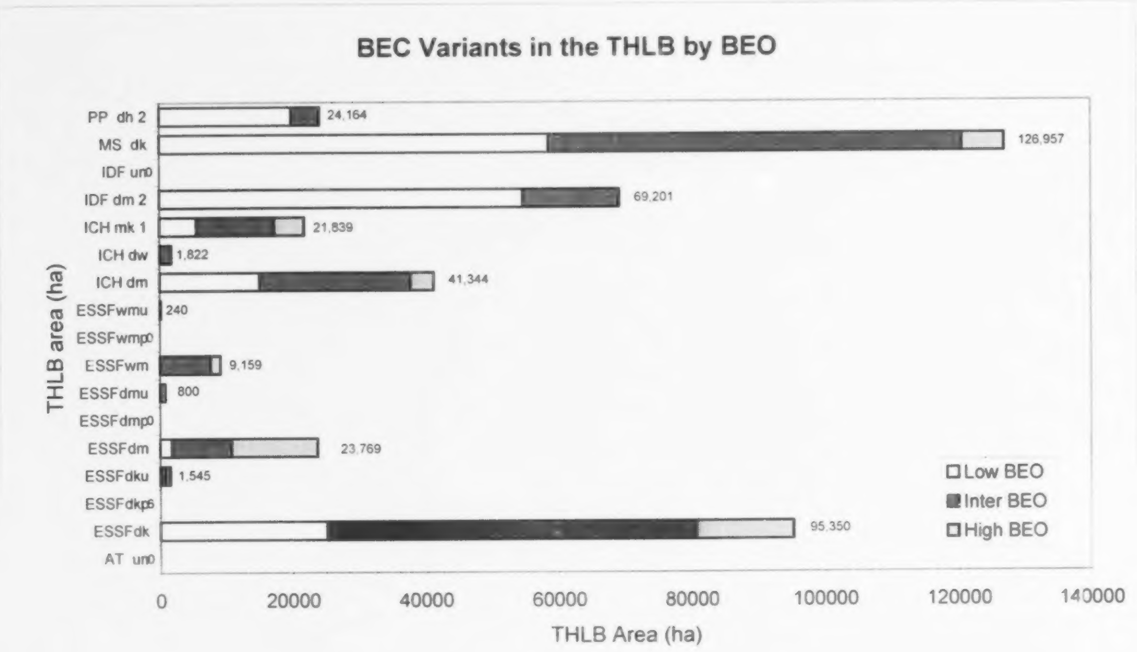
								Old Seral Goals			Old + Mature Seral Goals		
LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
8	Kimberley Watershed	I	ICH mk 1	3	93	130	152	14.0	18.2	18.6			
8	Kimberley Watershed	I	IDF dm 2	4	702	826	1,964	13.0	107.4	107.4			
8	Kimberley Watershed	I	MS dk	3	3,587	4,573	8,541	14.0	640.2	641.3			
Kimberley Watershed Total					12,556	21,632	34,204		2998.5	3009.8			
9	Yahk River	L	ESSFdk	3	6,364	8,774	9,809	4.7	412.4	412.4			
9	Yahk River	L	ESSFdm	3	1,725	1,892	2,072	4.7	88.9	92.5	14.0	264.8	265.9
9	Yahk River	L	ICH dm	3	11,680	14,425	15,342	4.7	678.0	679.6			
9	Yahk River	L	ICH mk 1	3	1,202	2,327	2,563	4.7	109.4	111.2	14.0	325.8	326.1
9	Yahk River	L	MS dk	3	4,883	5,759	6,252	4.7	270.7	270.9			
Yahk River Total					25,855	33,176	36,038		1559.3	1566.6		590.6	592.0
10	Bloom - Caven	L	ESSFdk	3	7,114	9,025	9,878	4.7	424.2	430.4			
10	Bloom - Caven	L	ESSFdku	3	30	63	116	4.7	2.9				
10	Bloom - Caven	L	ICH dm	3	2,561	3,262	3,527	4.7	153.3	158.7			
10	Bloom - Caven	L	ICH mk 1	3	5	5	7	4.7	0.2				
10	Bloom - Caven	L	IDF dm 2	4	3,293	4,075	4,928	4.3	175.2	177.0			
10	Bloom - Caven	L	MS dk	3	12,998	15,515	17,271	4.7	729.2	733.6			
Bloom - Caven Total					26,000	31,945	35,727		1485.1	1499.8			
11	Teepee Creek	L	ESSFdk	3	8,011	9,796	11,013	4.7	460.4	462.7			
11	Teepee Creek	L	ESSFdku	3	2	40	62	4.7	1.9				
11	Teepee Creek	L	ICH dm	3	652	727	904	4.7	34.2	19.4			
11	Teepee Creek	L	ICH mk 1	3	2,788	3,260	3,745	4.7	153.2	163.6			
11	Teepee Creek	L	IDF dm 2	4	1,355	1,713	2,185	4.3	73.7	73.8			
11	Teepee Creek	L	MS dk	3	7,994	9,960	11,425	4.7	468.1	468.5			
Teepee Creek Total					20,802	25,496	29,334		1191.4	1187.9			
12	Cranbrook Watershed	I	ESSFdk	3	6,795	9,815	10,387	14.0	1374.1	1378.9			
12	Cranbrook Watershed	I	ESSFdku	3	33	137	183	14.0	19.2	26.4			
12	Cranbrook Watershed	I	IDF dm 2	4	278	293	771	13.0	38.1	40.5			
12	Cranbrook Watershed	I	MS dk	3	4,814	5,879	7,899	14.0	823.0	829.8			
Cranbrook Watershed Total					11,920	16,124	19,240		2254.4	2275.5			
13	Galton Range	I	ESSFdk	3	1,045	6,099	7,594	14.0	853.8	878.0			
13	Galton Range	I	ESSFdku	3	16	325	866	14.0	45.4	47.9			
13	Galton Range	L	IDF dm 2	4	1,834	2,677	7,292	4.3	115.1	115.4			
13	Galton Range	L	MS dk	3	1,236	4,150	5,044	4.7	195.1	198.9			
13	Galton Range	L	PP dh 2	4	-	-	67	4.3					
Galton Range Total					4,132	13,251	20,864		1209.5	1240.2			
14	Wigwam River	H	ESSFdk	3	1,354	11,978	19,075	21.0	2515.4	2519.1	34.0	4072.5	4074.4
14	Wigwam River	H	ESSFdkp	5	-	-	60						
14	Wigwam River	H	ESSFdku	3	-	680	3,560	21.0	142.7	146.7			
14	Wigwam River	H	MS dk	3	3,917	6,639	8,247	21.0	1394.3	1394.4	39.0	2589.3	2499.3
Wigwam River Total					5,271	19,297	30,942		4052.3	4060.1		6661.8	6573.7
15	Lodgepole - Bighorn	H	ICH mk 1	3	1,137	3,271	5,786	21.0	686.9	687.4	34.0	1112.1	1113.1
15	Lodgepole - Bighorn	H	IDF dm 2	4	65	74	1,347	19.0	14.1	15.3			
15	Lodgepole - Bighorn	H	MS dk	3	2,258	5,002	8,740	21.0	1050.4	1050.4	39.0	1950.7	1953.0
15	Lodgepole - Bighorn	I	ESSFdk	3	2,305	8,136	13,169	14.0	1139.0	1143.6			
15	Lodgepole - Bighorn	I	ESSFdkp	5	-	-	519						
15	Lodgepole - Bighorn	I	ESSFdku	3	5	435	3,471	14.0	60.9	61.0			
15	Lodgepole - Bighorn	I	ESSFwm	2	603	2,641	4,997	9.0	237.7	239.8			
15	Lodgepole - Bighorn	I	ESSFwmp	5	-	37	932						
15	Lodgepole - Bighorn	I	ESSFwmu	2	35	658	2,525	9.0	59.2	60.4			
Lodgepole - Bighorn Total					6,407	20,254	41,486		3248.2	3257.8		3062.9	3066.1
16	West Flathead	I	ESSFdk	3	8,528	19,865	31,312	14.0	2781.1	2784.2			
16	West Flathead	I	ESSFdkp	5	-	52	1,400						
16	West Flathead	I	ESSFdku	3	113	1,006	5,892	14.0	140.9	145.1			
16	West Flathead	I	ESSFwmp	5	-	-	35						
16	West Flathead	I	MS dk	3	8,216	12,194	15,113	14.0	1707.1	1708.1			
West Flathead Total					16,856	33,116	53,752		4629.1	4637.4			
17	Upper Flathead	I	AT un	5	-	0	148						
17	Upper Flathead	I	ESSFdk	3	5,193	10,733	19,973	14.0	1502.7	1505.7			
17	Upper Flathead	I	ESSFdkp	5	-	108	1,890						
17	Upper Flathead	I	ESSFdku	3	155	1,899	8,092	14.0	265.9	274.3			
17	Upper Flathead	I	ESSFwm	2	-	-	114	9.0					
17	Upper Flathead	I	ESSFwmu	2	-	-	21	9.0					
17	Upper Flathead	I	MS dk	3	689	1,071	1,979	14.0	149.9	150.8			
Upper Flathead Total					6,037	13,812	32,216		1918.5	1930.8			
18	East Flathead	I	AT un	5	-	-	70						
18	East Flathead	I	ESSFdk	3	4,400	19,105	34,430	14.0	2674.7	2676.6			
18	East Flathead	I	ESSFdkp	5	-	12	3,247						
18	East Flathead	I	ESSFdku	3	-	1,324	10,837	14.0	185.3	235.3			
18	East Flathead	I	MS dk	3	14,111	19,717	22,963	14.0	2760.3	2763.5	26.0	5126.3	5128.0
East Flathead Total					18,511	40,157	71,547		5620.4	5675.3	26.0	5126.3	5128.0
19	Corbin Creek	L	AT un	5	-	4	546						

								Old Seral Goals			Old + Mature Seral Goals		
LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
19	Corbin Creek	L	ESSFdk	3	896	2,388	16,393	4.7	112.2	132.9			
19	Corbin Creek	L	ESSFdkp	5	5	16	3,271						
19	Corbin Creek	L	ESSFdku	3	32	449	8,078	4.7	21.1	33.6			
19	Corbin Creek	L	ESSFwm	2	-	0	1,931	3.0	0.0				
19	Corbin Creek	L	ESSFwmu	2	-	7	1,592	3.0	0.2				
19	Corbin Creek	L	IDF un	4	-	-	19						
19	Corbin Creek	L	MS dk	3	172	348	9,296	4.7	16.4				
	Corbin Creek Total				1,105	3,212	41,125		149.9	166.5			
20	Alexander - Line	I	AT un	5	-	6	1,509						
20	Alexander - Line	I	ESSFdk	3	1,622	5,887	16,334	14.0	824.2	829.6			
20	Alexander - Line	I	ESSFdkp	5	-	6	2,010						
20	Alexander - Line	I	ESSFdku	3	83	1,143	7,683	14.0	160.0	160.2			
20	Alexander - Line	I	IDF un	4	-	22	447						
20	Alexander - Line	I	MS dk	3	1,174	1,896	5,045	14.0	265.4	272.1			
	Alexander - Line Total				2,879	8,959	33,028		1249.5	1261.9			
21	Fording River	I	AT un	5	-	15	3,468						
21	Fording River	I	ESSFdk	3	2,998	8,991	20,055	14.0	1258.7	1261.8			
21	Fording River	I	ESSFdkp	5	-	29	5,897						
21	Fording River	I	ESSFdku	3	132	1,686	9,892	14.0	236.1	236.1			
21	Fording River	I	MS dk	3	401	805	4,886	14.0	112.6	115.6			
	Fording River Total				3,530	11,526	44,198		1607.4	1613.5			
22	Upper Elk	I	AT un	5	-	8	10,329						
22	Upper Elk	I	ESSFdk	3	3,080	15,594	25,459	14.0	2183.1	2183.1	23.0	3586.5	3603.4
22	Upper Elk	I	ESSFdkp	5	-	41	11,244						
22	Upper Elk	I	ESSFdku	3	39	1,947	12,973	14.0	272.5	274.5			
22	Upper Elk	I	MS dk	3	3,295	4,754	6,301	14.0	665.6	680.1	26.0	1236.1	1175.1
	Upper Elk Total				6,414	22,343	66,305		3121.2	3137.7		4822.6	4778.4
23	West Elk	H	AT un	5	-	-	2,191						
23	West Elk	H	ESSFdk	3	598	12,534	21,389	21.0	2632.1	2635.0	34.0	4261.6	4265.7
23	West Elk	H	ESSFdkp	5	-	126	7,546						
23	West Elk	H	ESSFdku	3	8	2,685	12,953	21.0	563.8	567.3			
23	West Elk	I	MS dk	3	6,635	11,675	20,353	14.0	1634.6	1637.4			
	West Elk Total				7,241	27,020	64,431		4830.5	4839.7		4261.6	4265.7
24	Lower Elk	H	AT un	5	-	-	144						
24	Lower Elk	H	ESSFdk	3	64	598	2,767	21.0	125.5	131.3			
24	Lower Elk	H	ESSFdkp	5	1	27	177						
24	Lower Elk	H	ESSFdku	3	46	241	1,082	21.0	50.7	51.9			
24	Lower Elk	H	ESSFwm	2	446	2,808	17,394	13.0	365.0	367.8			
24	Lower Elk	H	ESSFwmp	5	-	177	1,691						
24	Lower Elk	H	ESSFwmu	2	13	707	8,212	13.0	92.0	101.6			
24	Lower Elk	H	ICH mk 1	3	3,413	9,396	32,601	21.0	1973.1	1973.4			
24	Lower Elk	H	IDF dm 2	4	27	146	536	19.0	27.7				
24	Lower Elk	H	MS dk	3	236	1,288	6,008	21.0	270.5	298.8			
	Lower Elk Total				4,246	15,387	70,611		2904.4	2924.8			
25	Sand Creek	I	ESSFdk	3	148	1,268	2,233	14.0	177.6	178.5			
25	Sand Creek	I	ESSFdku	3	3	161	1,047	14.0	22.6	24.2			
25	Sand Creek	I	ESSFwm	2	233	2,491	5,455	9.0	224.2	227.7			
25	Sand Creek	I	ESSFwmp	5	-	-	52						
25	Sand Creek	I	ESSFwmu	2	-	119	1,282	9.0	10.7	14.1			
25	Sand Creek	I	ICH dm	3	1,063	3,263	4,675	14.0	456.8	457.1			
25	Sand Creek	I	IDF dm 2	4	178	450	876	13.0	58.6	58.7			
25	Sand Creek	I	MS dk	3	399	1,894	3,180	14.0	265.2	265.2			
	Sand Creek Total				2,024	9,647	18,799		1215.6	1225.5			
26	Iron - Sulphur	I	AT un	5	-	-	607						
26	Iron - Sulphur	I	ESSFdk	3	956	3,836	6,502	14.0	537.0	537.8			
26	Iron - Sulphur	I	ESSFdkp	5	-	-	340						
26	Iron - Sulphur	I	ESSFdku	3	-	430	2,397	14.0	60.2	61.5			
26	Iron - Sulphur	I	ESSFwm	2	1,057	4,562	8,271	9.0	410.6	410.7			
26	Iron - Sulphur	I	ESSFwmp	5	-	28	1,668						
26	Iron - Sulphur	I	ESSFwmu	2	3	405	3,141	9.0	36.4	49.9			
26	Iron - Sulphur	I	ICH mk 1	3	4,659	10,504	12,917	14.0	1470.6	1470.7			
26	Iron - Sulphur	I	IDF dm 2	4	5	109	151	13.0	14.1	14.3			
26	Iron - Sulphur	I	MS dk	3	1,151	2,174	2,728	14.0	304.4	306.6			
	Iron - Sulphur Total				7,832	22,048	38,722		2833.4	2851.5			
27	Upper Bull	I	AT un	5	-	0	4,610						
27	Upper Bull	I	ESSFdk	3	4,292	14,808	28,080	14.0	2073.1	2074.0			
27	Upper Bull	I	ESSFdkp	5	-	86	6,922						
27	Upper Bull	I	ESSFdku	3	53	1,765	11,940	14.0	247.1	259.2			
27	Upper Bull	I	MS dk	3	5,552	8,574	10,378	14.0	1200.4	1201.6			
	Upper Bull Total				9,897	25,233	61,929		3520.6	3534.8			
28	Galbraith - Dibble	I	AT un	5	-	-	810						

								Old Seral Goals			Old + Mature Seral Goals		
LU #	LU Name	BEO	BEC	NDT	THLB Area (ha)	CFLB Area (ha)	Total Area (ha)	%	Target (ha)	OGMA (ha)	%	Target (ha)	OGMA (ha)
28	Galbraith - Dibble	I	ESSFdk	3	1,070	3,778	7,608	14.0	529.0	529.0			
28	Galbraith - Dibble	I	ESSFdkp	5	-	1	1,973						
28	Galbraith - Dibble	I	ESSFdku	3	10	287	3,057	14.0	40.2	44.2			
28	Galbraith - Dibble	I	ESSFwm	2	2,053	6,045	9,123	9.0	544.0	545.5			
28	Galbraith - Dibble	I	ESSFwmp	5	-	139	4,002						
28	Galbraith - Dibble	I	ESSFwmu	2	177	1,258	3,994	9.0	113.2	117.2			
28	Galbraith - Dibble	I	ICH dm	3	936	2,086	2,496	14.0	292.1	292.1			
28	Galbraith - Dibble	I	ICH mk 1	3	4,141	7,982	9,324	14.0	1117.5	1118.7			
28	Galbraith - Dibble	I	IDF dm 2	4	5	52	143	13.0	6.8	6.8			
28	Galbraith - Dibble	I	MS dk	3	3,641	5,272	6,578	14.0	738.1	738.7			
Galbraith - Dibble Total					12,033	26,901	49,109		3380.8	3392.2			
29	Wildhorse - Steeples	I	AT un	5	-	-	772						
29	Wildhorse - Steeples	I	ESSFdk	3	2,800	9,318	11,977	14.0	1304.5	1309.0			
29	Wildhorse - Steeples	I	ESSFdkp	5	-	487	4,385						
29	Wildhorse - Steeples	I	ESSFdku	3	160	2,613	6,204	14.0	365.8	380.1			
29	Wildhorse - Steeples	I	ESSFwmp	5	-	-	39						
29	Wildhorse - Steeples	I	IDF dm 2	4	559	1,191	1,761	13.0	154.9	155.5			
29	Wildhorse - Steeples	I	MS dk	3	1,968	6,267	7,711	14.0	877.3	879.0			
Wildhorse - Steeples Total					5,486	19,875	32,850		2702.4	2723.6			
30	Cranbrook	L	ESSFdk	3	513	739	777	4.7	34.7	34.8			
30	Cranbrook	L	ICH mk 1	3	9	183	241	4.7	8.6				
30	Cranbrook	L	IDF dm 2	4	9,937	11,383	26,147	4.3	489.5	493.3			
30	Cranbrook	L	MS dk	3	7,630	9,187	10,958	4.7	431.8	441.8			
30	Cranbrook	L	PP dh 2	4	2,021	2,608	8,506	4.3	112.1	112.2			
Cranbrook Total					20,110	24,101	46,629		1076.8	1082.1			
31	Lost Dog - Mather	I	AT un	5	-	-	79						
31	Lost Dog - Mather	I	ESSFdk	3	800	2,662	3,185	14.0	372.7	372.9			
31	Lost Dog - Mather	I	ESSFdkp	5	-	58	821						
31	Lost Dog - Mather	I	ESSFdku	3	-	888	1,655	14.0	124.4	128.2			
31	Lost Dog - Mather	L	IDF dm 2	4	1,472	1,708	2,552	4.3	73.5	73.6			
31	Lost Dog - Mather	L	MS dk	3	8,869	9,848	11,998	4.7	462.8	478.9			
Lost Dog - Mather Total					11,141	15,166	20,290		1033.4	1053.5			
32	St. Mary's Prairie -	L	IDF dm 2	4	2,284	2,710	4,339	4.3	116.5	130.3			
32	St. Mary's Prairie -	L	MS dk	3	257	275	1,034	4.7	12.9				
32	St. Mary's Prairie -	L	PP dh 2	4	5,765	6,406	26,388	4.3	275.5	296.6			
St. Mary's Prairie - Total					8,306	9,391	31,761		404.9	426.9			
33	Wasa - Picture Valle	I	IDF dm 2	4	7,281	9,058	18,213	13.0	1177.6	1180.4			
33	Wasa - Picture Valle	I	PP dh 2	4	3,976	5,093	13,540	13.0	662.1	686.1			
33	Wasa - Picture Valle	L	MS dk	3	10	22	31	4.7	1.0				
Wasa - Picture Valle Total					11,266	14,173	31,784		1840.7	1866.4			
34	Jaffray - Baynes Lak	L	IDF dm 2	4	16,400	18,307	36,278	4.3	787.2	799.1			
34	Jaffray - Baynes Lak	L	MS dk	3	213	252	308	4.7	11.8				
34	Jaffray - Baynes Lak	L	PP dh 2	4	4,074	4,542	10,224	4.3	195.3	199.1			
Jaffray - Baynes Lak Total					20,687	23,101	46,810		994.3	998.3			
35	Tobacco Plains	L	IDF dm 2	4	2,197	2,322	4,862	4.3	99.8	103.4			
35	Tobacco Plains	L	PP dh 2	4	5,091	5,534	15,752	4.3	238.0	239.2			
Tobacco Plains Total					7,287	7,856	20,614		337.8	342.6			
36	Mayook - Wardner	I	ESSFdk	3	1,288	1,868	2,051	14.0	261.5	270.9			
36	Mayook - Wardner	I	ESSFdku	3	-	42	46	14.0	5.8				
36	Mayook - Wardner	I	IDF dm 2	4	4,921	5,309	12,252	13.0	690.2	692.0			
36	Mayook - Wardner	I	MS dk	3	5,744	6,598	8,234	14.0	923.8	924.2			
36	Mayook - Wardner	I	PP dh 2	4	328	381	1,347	13.0	49.5	51.0			
Mayook - Wardner Total					12,281	14,198	23,930		1930.8	1938.0			
37	Linklater - Englishm	L	ESSFdk	3	2,228	3,284	3,574	4.7	154.4	166.6			
37	Linklater - Englishm	L	ESSFdku	3	-	18	104	4.7	0.8				
37	Linklater - Englishm	L	IDF dm 2	4	14,320	15,345	19,273	4.3	659.8	660.2			
37	Linklater - Englishm	L	MS dk	3	4,153	4,520	4,936	4.7	212.4	216.1			
37	Linklater - Englishm	L	PP dh 2	4	2,906	3,182	6,469	4.3	136.8	138.7			
Linklater - Englishm Total					23,607	26,349	34,355		1164.3	1181.6			
38	East Elk	L	AT un	5	-	-	77						
38	East Elk	L	ESSFdk	3	-	3	9,018	4.7	0.1				
38	East Elk	L	ESSFdkp	5	-	-	478						
38	East Elk	L	ESSFdku	3	-	-	1,733	4.7					
38	East Elk	L	IDF un	4	-	-	432						
38	East Elk	L	MS dk	3	610	1,015	19,481	4.7	47.7	60.1			
East Elk Total					610	1,018	31,220		47.8	60.1			
Cranbrook Totals					416,196	760,590	1,484,302		89356	90177	28.0	30436.8	30319.7
										100.9%			99.6%

Appendix E – THLB / CFLB Areas by BEC/BEO


BEC Variants in the CFLB by BEO


BEC Variants in the THLB by BEO

Appendix F – Analysis Unit Volumes

Cranbrook Effective Exisiting Yields by AU

	Existing Natural Stands																							Existing Managed Stands						
	101	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**150**	**151**	**152**	**153**	**501**	**502**	**503**	**504**	**505**	**506**	**507**
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	5	0	0	3	2	1	2	26	0	1	1	23	0	0	3	0	0	0	0	0	9	10	0	14	15	12
40	9	5	0	6	35	1	10	28	21	3	36	80	7	4	33	76	0	2	26	0	0	0	0	8	42	43	11	57	60	51
50	32	18	3	27	71	7	34	82	53	24	74	127	22	33	71	123	1	21	58	0	0	0	0	31	90	92	42	112	117	97
60	56	31	15	51	107	19	71	133	90	53	109	169	36	62	105	164	10	46	93	9	0	5	0	53	133	141	84	162	167	141
70	79	43	30	75	142	41	108	179	126	78	141	205	49	89	135	200	28	73	128	26	16	14	9	74	169	184	133	204	209	179
80	100	55	46	98	175	65	140	219	159	102	169	237	60	113	163	231	47	101	162	43	38	23	21	95	200	219	177	240	244	213
90	121	67	61	120	207	89	168	254	186	124	195	267	71	136	189	260	67	128	195	59	60	32	33	115	228	251	213	270	275	243
100	141	78	76	142	237	111	193	283	210	145	219	295	81	157	212	287	87	155	228	74	80	41	44	134	252	281	244	296	299	268
110	160	88	90	163	265	132	215	309	231	164	242	320	91	177	235	312	107	180	258	89	100	49	55	152	271	302	271	314	319	288
120	177	98	104	181	290	150	235	332	250	183	263	344	100	196	255	335	125	204	286	102	119	56	65	168	286	318	296	328	334	309
130	193	106	116	199	313	169	256	353	270	200	283	366	108	214	275	356	143	226	312	115	136	63	75	183	300	332	317	343	347	325
140	208	114	127	215	333	187	275	372	289	213	297	381	114	227	288	371	158	246	334	126	152	70	83	196	313	343	337	353	358	339
150	221	121	137	228	349	203	291	387	305	223	307	391	119	237	298	382	169	258	347	136	165	75	91	209	322	354	355	362	367	353
160	232	128	145	239	363	217	306	400	320	231	315	399	122	245	306	389	176	266	355	145	176	80	97	219	332	362	370	370	376	365
170	242	133	152	247	374	230	320	411	333	236	319	402	124	249	310	393	180	270	359	152	185	84	102	229	340	369	385	376	382	376
180	252	138	159	256	384	242	332	421	346	239	321	403	125	252	312	394	182	272	360	160	193	88	106	238	347	376	395	381	387	384
190	261	143	165	263	393	253	343	429	357	239	321	403	125	252	312	394	184	273	361	166	201	91	111	246	353	381	407	386	392	392
200	270	148	171	271	402	264	354	438	368	242	322	403	126	255	313	395	185	275	362	173	209	96	115	255	357	385	414	389	395	399
210	278	153	177	278	410	274	364	445	379	246	324	405	127	258	316	397	187	276	364	180	217	99	119	263	361	390	422	392	397	406
220	287	158	183	285	418	284	374	452	390	249	327	407	128	261	319	400	188	278	365	185	224	102	123	271	362	392	429	393	399	410
230	294	162	188	291	426	292	383	459	401	251	330	410	129	264	321	402	190	279	366	190	231	104	127	278	364	394	435	395	402	415
240	301	166	193	297	433	301	391	465	412	254	332	412	130	266	323	405	191	280	367	194	238	107	131	285	365	395	441	396	402	418
250	308	169	196	303	440	309	400	470	422	257	334	414	131	269	326	407	192	281	368	199	245	109	135	291	365	396	447	396	402	421
260	309	170	198	303	441	312	402	473	425	259	336	416	132	271	328	409	192	281	369	200	246	110	135	292	365	398	451	397	402	422
270	311	171	199	304	441	316	405	475	427	260	338	418	132	272	329	411	192	282	369	201	248	110	136	294	365	398	454	397	402	425
280	312	172	199	304	441	318	407	477	429	262	339	420	133	274	331	412	192	282	370	202	249	111	137	295	365	399	459	397	402	427
290	313	172	199	304	441	321	409	479	430	263	341	421	134	275	332	414	192	282	370	202	250	111	138	296	365	399	459	397	402	428
300	315	173	199	305	442	324	411	480	432	265	342	423	134	276	333	415	192	282	370	203	251	112	138	297	365	399	459	397	402	428
310	315	173	199	305	442	326	412	481	433	266	343	424	135	277	334	417	192	282	370	203	251	112	138	297	365	399	459	397	402	428
320	315	173	199	305	442	328	414	483	435	267	344	425	135	278	335	418	192	282	370	203	251	112	138	297	365	399	459	397	402	428
330	315	173	199	305	442	330	415	484	436	267	345	426	135	279	336	419	192	282	370	203	251	112	138	297	365	399	459	397	402	428
340	315	173	199	305	442	332	416	484	437	268	348	427	136	280	337	420	192	282	370	203	251	112	138	297	365	399	459	397	402	428
350	315	173	199	305	442	333	417	485	438	269	346	428	136	280	337	420	192	282	370	203	251	112	138	297	365	399	459	397	402	428

Cranbrook Effective Future Yields by AU

	Future Managed Stands																								
	201	**203**	**204**	**205**	**206**	**207**	**208**	**209**	**210**	**211**	**212**	**213**	**214**	**215**	**216**	**217**	**218**	**219**	**251**	**601**	**602**	**603**	**604**	**605**	**606**	**607**
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	10	0	0	0	0
30	0	0	0	8	0	1	19	0	1	10	39	1	1	7	34	0	0	4	0	0	9	44	0	15	15	13
40	8	0	5	46	0	10	91	2	8	42	111	21	10	37	105	0	4	39	1	8	43	98	12	59	62	53
50	31	2	24	106	4	52	178	24	25	93	183	56	31	88	180	1	25	99	11	31	93	148	47	115	120	101
60	53	9	55	170	26	110	253	68	51	143	243	97	63	140	241	7	64	163	23	53	135	193	94	167	170	144
70	74	23	92	219	61	164	317	119	82	187	293	137	101	187	296	21	104	216	34	74	172	229	143	208	212	183
80	95	42	130	264	101	211	366	168	113	222	330	173	136	225	337	43	143	263	45	95	204	262	186	244	247	218
90	115	65	161	301	137	258	400	214	141	257	360	201	168	262	364	65	178	305	56	115	231	291	224	275	279	249
100	134	85	189	334	171	295	428	252	167	283	384	226	194	291	386	87	207	341	67	134	254	311	254	299	304	273
110	152	106	211	363	204	322	449	281	188	303	402	251	220	315	403	108	232	374	77	152	272	327	282	317	322	293
120	168	125	231	386	233	341	463	304	206	320	416	271	242	331	417	129	256	402	87	168	288	340	304	331	337	312
130	183	141	250	403	257	357	467	323	225	333	428	286	263	342	427	148	276	425	96	183	301	351	326	345	350	330
140	196	154	263	418	274	370	472	340	240	343	433	297	278	353	432	163	294	441	104	196	315	361	344	355	359	344
150	209	166	276	433	289	382	472	355	252	353	437	307	291	362	433	175	309	461	110	209	325	370	362	364	370	358
160	219	176	287	433	300	390	472	367	260	360	441	314	300	368	435	187	323	476	116	219	334	377	377	372	377	370
170	229	184	297	433	311	399	472	377	269	367	443	321	310	376	436	196	335	488	121	229	343	382	389	379	383	380
180	238	190	306	433	319	404	472	386	278	372	444	326	315	379	437	205	348	497	125	238	349	387	402	384	388	387
190	246	198	314	433	326	406	472	394	282	377	444	331	322	383	438	214	358	506	129	246	353	391	411	387	392	396
200	255	204	319	433	333	407	472	400	287	378	444	333	326	385	438	222	366	513	133	255	358	394	418	389	395	404
210	263	209	324	433	339	408	472	404	291	380	444	336	329	386	438	228	374	519	137	263	361	397	424	392	398	408
220	271	212	327	433	342	409	472	407	296	380	444	340	331	386	438	235	379	523	141	271	363	398	431	395	400	412
230	278	215	330	433	347	410	472	411	299	381	444	342	335	386	438	239	384	527	144	278	366	400	436	396	402	417
240	285	217	331	433	349	410	472	414	300	383	444	342	336	386	438	245	389	527	148	285	366	402	444	397	402	420
250	291	221	333	433	351	411	472	416	302	383	444	342	337	386	438	249	392	527	151	291	366	404	447	397	403	423
260	292	222	333	433	352	411	472	420	305	383	444	342	339	386	438	254	396	527	152	292	368	404	452	397	403	425
270	294	222	334	433	352	411	472	421	305	383	444	342	339	386	438	258	399	527	153	294	368	404	455	397	403	426
280	295	224	334	433	352	411	472	424	307	383	444	342	342	386	438	261	401	527	153	295	368	404	459	397	403	429
290	296	224	334	433	352	411	472	424	307	383	444	342	342	386	438	263	404	527	154	296	368	404	460	397	404	430
300	297	224	334	433	352	411	472	424	307	383	444	342	342	386	438	263	404	527	155	297	368	404	460	397	404	430
310	297	224	334	433	352	411	472	424	307	383	444	342	342	386	438	263	404	527	155	297	368	404	460	397	404	430
320	297	224	334	433	352	411	472	424	307	383	444	342	342	386	438	263	404	527	155	297	368	404	460	397	404	430
330	297	224	334	433	352	411	472	424	307	383	444	342	342	386	438	263	404	527	155	297	368	404	460	397	404	430
340	297	224	334	433	352	411	472	424	307	383	444	342	342	386	438	263	404	527	155	297	368	404	460	397	404	430
350	297	224	334	433	352	411	472	424	307	383	444	342	342	386	438	263	404	527	155	297	368	404	460	397	404	430

Appendix G – Socio-Economic Analysis Background Information

Estimates of forest industry *direct* employment are based on surveys of TSA licensees and processors of TSA timber about their harvesting, timber consumption and employment. The survey responses provide the basis for calculating coefficients of direct employment per '000 m^3 in silviculture, harvesting and processing. The ratios are expressed as person-years[58] (PYs) per '000 m^3 of harvested timber.

Direct employment is calculated at the TSA and provincial levels as follows.

- TSA direct employment consists of employees and contractors who are engaged in TSA forest industry work and who reside in communities within the TSA.
- Provincial direct employment consists of employees and contractors who are engaged in TSA harvesting and silviculture and who reside within the TSA plus those who come to the TSA to work in harvesting and silviculture.
- Provincial direct employment also consists of employees and contractors who are engaged in processing TSA timber outside of the TSA and who reside outside of the TSA.

Estimates of TSA forest industry *indirect and induced* employment are achieved by multiplying TSA *direct* employment by indirect and induced employment multipliers that are calculated by BC Stats. The indirect and induced multipliers are assembled from information contained in the BC Government's Input-Output (I/O) model and the 2001 Census. Following is a table that presents Cranbrook TSA and province-wide indirect/induced and total multipliers for the forestry, wood saw milling and pulp and paper processing industries. Multiplying the aforementioned direct employment coefficients by the indirect/induced multipliers yields a total direct employment coefficient.

Table: Provincial and Cranbrook TSA Indirect/Induced Forest Industry Multipliers

	Harvesting & Silviculture	**Pulp & paper**	**Other Wood Processing**
Provincial level multiplier	1.77	2.83	2.78
TSA level multiplier[59]	1.28	2.00	1.50

Source: Horne March 2004 and author's calculations

Forest sector employment income estimates were calculated by multiplying the direct forest industry employment estimates by Statistics Canada 2001 Census employment income data for BC harvesting, silviculture, pulp making and saw milling industries. Indirect and induced employment income estimates were calculated by multiplying the indirect and induced employment by the BC all industries average employment income from the 2001 Census.

Economic activity estimates calculated with the aid of employment coefficients per '000 m^3 of harvested timber and indirect and induced multipliers include the following assumptions and caveats.

- The future employment estimates are based on current labour productivity relationships, despite knowledge that labour productivity in the forest industry improves slowly over time. These employment estimates, which use current productivity relationships, are satisfactory in the short-term but in the medium- and long-term are likely to be slight overestimates.

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[58] A person-year of employment is a full-time job that lasts at least 180 days per year. The surveys of licensees and processors capture information about part-time jobs; they are converted to equivalent full-time person-years of employment in the employment estimation.

[59] This multiplier incorporates the assumption that employment insurance and other social safety net programs to employed and displaced workers will temporarily encourage them not to leave the community, thereby reducing the induced impacts of a lower harvest level.

- Changes in harvest levels are posited as the main driver in employment changes. For the harvesting sector, this assumption is correct but silviculture and processing sectors have other forces that are also important drivers of employment change. For the processing sector, employment changes are likely to occur discontinuously in "lumps" rather than continuously with small shifts in timber supply. The employment coefficients do not take into account the other forces that drive change in silviculture and processing. Despite this shortcoming, the approach of using employment coefficients and multipliers is valid for the purposes of comparing alternative scenarios for processing as well as harvesting sectors.

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